

# Research Report 2014–2016

Max-Planck-Institut für Bildungsforschung  
Max Planck Institute for Human Development





# Research Report 2014 – 2016





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Max Planck I

## Impressum

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**Für Bildungsforschung**  
Institute for Human Development

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# Introduction

## Editorial

Again, the Institute can look back on three productive years. This productivity is aided by context. At the institutional level, the public funding of the Max Planck Society endows the Institute with scientific freedom and independence. At the individual level, thousands of Berliners contribute to our research activities as study participants. In light of increasing resentments against scientific thinking and scholarship, the Institute is grateful to enjoy these and many other forms of societal support and recognition.

As a complement to the four large research centers, the Max Planck Research Groups (MPRG) enrich the intellectual life of the Institute and add to its scientific profile. While the MPRG "Affect Across the Lifespan," led by Michaela Riediger, as well as the MPRG "Felt Communities? Emotions in European Music Performances," led by Sven Oliver Müller, reached the end of their terms, the MPRG "Reading Education and Development (REaD)," led by Sascha Schroeder, continued its work on reading development, and the MPRG "Naturalistic Social Cognition," newly established by Annie E. Wertz in 2015, investigates how infants and young children think about and learn from other people in naturalistic circumstances, with a primary focus on the learning strategies that infants use to acquire information about plants. Furthermore, the MPRG "iSearch—Information Search, Ecological and Active Learning Research with Children," led by Azzurra Ruggeri, was established in early 2017, and the MPRG "NeuroCode—Neural and Computational Basis of Learning, Memory, and Decision Making," led by Nicolas W. Schuck, will follow suit later this year.

In 2014, the Max Planck Society and University College London (UCL) established the "Max Planck UCL Centre for Computational Psychiatry and Ageing Research." The Centre has two sites, one located in London and the other at our Institute, and is co-directed by Ray Dolan (UCL) and Ulman Lindenberger. The Centre works toward a mechanistic understanding of behavioral aging and psychopathology. A new doctoral program affiliated with the Centre, the International Max Planck Research School on Computational Methods in Psychiatry and Ageing Research (COMP2PSYCH) was founded in 2016 and has recruited the first cohorts of graduate students. Like the Centre, COMP2PSYCH is located in London and Berlin.

As special honors, both to them personally and to the Institute, Ute Frevert received the Order of Merit First Class of the Federal Republic of Germany in 2016, and Ralph Hertwig received the Gottfried Wilhelm Leibniz Prize of the German Research Foundation in early 2017.

Detailed information on the structure, programs, and findings of the Institute's scientific activities is provided on the following pages, which are supplemented by overviews in the Appendix. Publications during the reporting period are listed separately by each center or group. Hence, publications with authors from more than one center or group are listed more than once, documenting collaborations across the various research units of the Institute. Also, many publications by researchers at the Institute show that the opportunities established by the opening of the Magnetic Resonance Imaging Laboratory in 2012 have yielded rich fruit over the past years.

Berlin, April 2017

For the Board of Directors:  
Ulman Lindenberger

## Overview

The MPI for Human Development, founded in 1963, is a multidisciplinary research institution dedicated to the study of human development and education. Its inquiries are broadly defined, encompassing evolutionary, historical, social, and institutional contexts of individual human development from infancy to old age. The disciplines of psychology, history, and education, which reflect the current directors' backgrounds, are enriched by the work of colleagues from behavioral and developmental neuroscience, evolutionary biology, economics, mathematics, computer science, sociology, and the humanities.

The Institute is one of more than 80 research institutes financed by the Max Planck Society for the Advancement of Science (Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.), the core support for which is provided by the Federal Republic of Germany and its 16 states. The Institute employs a total of 108 permanent staff including 31 researchers, supplemented by a varying number of predoctoral, postdoctoral, and affiliated researchers and visiting fellows, as well as student assistants.

### Research Centers

During the 2014–2016 period, the following research centers contributed to research at the Institute: The **Center for Adaptive Behavior and Cognition (ABC)** (Director: Gerd Gigerenzer) took up its work in 1997. The Center investigates human rationality, specifically decision making and risk perception in an uncertain world. Current research focuses on (1) adaptive and ecological rationality, that is, heuristic decision making by experts and laypeople in situations under uncertainty as opposed to known risks; (2) social intelligence in cooperation and competition; and (3) risk understanding and uncertainty management in everyday life, including applications in medicine, law, education, and financial regulation. Each of these research areas emphasizes the evolutionary foundations of behavior and cognition, in particular their domain specificity and functional adaptiveness (pp. 15–52).

The **Center for Adaptive Rationality (ARC)** (Director: Ralph Hertwig) was established in 2012. The Center investigates how people make decisions in complex and uncertain environments. ARC's research focuses on (1) bounded rationality, that is, the simple strat-

egies that people enlist in order to navigate a complex and uncertain world; (2) information search, learning, and experience-based decision making as key processes for reckoning with uncertainty; (3) the development of decision making over the lifespan and the influence of cognitive aging; (4) the use of collective intelligence to cope with uncertainty; and (5) evidence-supported ways to boost individuals' competences and thus enable better decisions. In each of these research areas a variety of methods are employed, including behavioral experiments, computer simulations, mathematical analyses, and neuroscientific investigations (pp. 53–96).

The **Center for the History of Emotions (HoE)** (Director: Ute Frevert), which opened in 2008, examines emotions as a major feature of human development both in an ontogenetic and a phylogenetic sense. The research rests on the assumption that emotions—feelings and their expressions—are shaped by culture and learned in social contexts through social practices. Since these contexts and practices change in space and time, emotions are held to be historically variable. In order to detect and explore this variability, the Center's scope includes different societies within and outside Europe. Special attention is paid to institutions that have a strong impact on human behavior and development, such as the family, school, law, religion, the economy, the military, and the state, as they have developed since the (early) modern period (pp. 97–138).

The **Center for Lifespan Psychology (LIP)** (Director: Ulman Lindenberger), founded in 1981 by Paul B. Baltes and led by Ulman Lindenberger since 2004, has helped to establish lifespan psychology as a distinct conceptual approach within developmental



The Institute is home to four research centers and several research groups.

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psychology and developmental cognitive neuroscience. Work at the Center is guided by three propositions: (1) to study lifespan changes in behavior as interactions among maturation, learning, and senescence; (2) to develop theories and methods that integrate empirical evidence across domains of functioning, timescales, as well as behavioral and neural levels of analysis; and (3) to identify mechanisms of development by exploring age-graded differences in plasticity (pp. 139–184).

**The Harding Center for Risk Literacy** (Director: Gerd Gigerenzer), as part of the Center for Adaptive Behavior and Cognition, was founded in 2009 with a donation from the London investment banker David Harding. Its key research topic is risk literacy in a modern technological world, with a focus on health care. To date, the Center has taught over 1,000 physicians how to better understand health statistics and works on implementing risk literacy in schools and lobbying for transparent health information (pp. 185–194).

**The Max Planck UCL Centre for Computational Psychiatry and Ageing Research** (Directors: Ray Dolan, London, and Ulman Lindenberger, Berlin) was established in April

2014 as a joint initiative of the Max Planck Society and the University College London. The Centre fosters a mechanistic understanding of behavioral aging and psychopathology by developing and applying statistical and computational tools to delineate individual differences in brain–behavior dynamics (pp. 195–200).

#### **Max Planck Research Groups**

During the reporting period, several research groups have broadened the scope of the Institute's research agenda.

**The Max Planck Research Group "Naturalistic Social Cognition"** (Head: Annie E. Wertz) investigates social learning and cognitive development from an evolutionary perspective, with a focus on infancy and early childhood. The group's research program is primarily organized around investigating a learning problem that confronted our ancestors across human evolution: acquiring information about plants. This group was established in 2015 (pp. 201–214).

**The Max Planck Research Group "Reading Education and Development" (REaD)** (Head: Sascha Schroeder), which was formed in July 2012, investigates the underlying structure of

students' reading skills and their development during childhood and adolescence. The group aims at a detailed description of the cognitive processes involved in reading development, including its prerequisites and consequences (pp. 215–230).

The **Max Planck Research Group "Affect Across the Lifespan"** (Head: Michaela Riediger) investigated age differences in affective experiences and competencies from adolescence to old age. A first research emphasis on affect dynamics involved investigations on age differences in the inner experiences, outward expressions, and physiological processes associated with affective experience. A second research emphasis on affective competencies focused on age differences in abilities related to understanding and managing emotional aspects of life. The group started in 2009 and ended in December 2014 (pp. 231–240).

The **Max Planck Research Group "Felt Communities? Emotions in European Music Performance"** (Head: Sven Oliver Müller) studied the historical development of the emotions triggered by music in the 19th and 20th centuries. Focusing on emotions as a public form of communication, the group aimed at deciphering the emotional structure of communities. The group started its work in 2010 and ended in summer 2015 (pp. 241–250).

The **Heisenberg Research Group "Socio-emotional Development and Health Across the Lifespan"** (Head: Michaela Riediger) investigates how and why individuals from different age groups differ in social and emotional experiences and competencies and how these processes are related to health behaviors and outcomes. The research group is part of a cooperation of the Freie Universität Berlin and the MPI for Human Development. The group started its work in September 2015 (pp. 251–256).

The **Otto Hahn Research Group on Associative Memory in Old Age** (Head: Yvonne Brehmer) explores mechanisms contributing to individual differences in associative memory among older adults. This group was established in December 2012 and is funded by an Otto Hahn Award of the Max Planck

Society. The group's work is primarily based on data from the Swedish National Study on Aging and Care (SNAC-K), which is coordinated by the Aging Research Center (ARC) at the Karolinska Institutet in Stockholm, Sweden (pp. 257–262).

#### **Max Planck Fellowship**

Several years ago, the Max Planck Society established the Max Planck Fellow Program to further strengthen research collaboration between its institutes and neighboring universities and other research institutions. In June 2008, Gert G. Wagner was appointed Max Planck Fellow at the Institute. Gert G. Wagner is Professor of Economics at the Technische Universität Berlin and one of the leading researchers of the German Socio-Economic Panel Study (SOEP). Since 2011, he is also a member of the Executive Board of the German Institute for Economic Research (DIW Berlin), which hosts the SOEP. Gert G. Wagner's presence at the Institute as a fellow facilitates collaboration between the Institute's researchers and the SOEP group at DIW Berlin. Gert G. Wagner is also a faculty member of the International Max Planck Research School on the Life Course (LIFE) and among the principal investigators of the Berlin Aging Studies (pp. 263–268).

#### **Research Programs of the Directors Emeriti**

The Directors emeriti Jürgen Baumert, Wolfgang Edelstein, and Karl Ulrich Mayer continue to pursue their research programs at the MPI for Human Development. Supported by funds from the President of the Max Planck Society, Jürgen Baumert's work focuses on the reform of the Berlin secondary school system, the relationship between students' educational resources and their life course, the development of teachers' professional competence, and the potential of bilingual alphabetization in multicultural societies. Wolfgang Edelstein's work focuses on socio-moral development, democracy education, and democratic school reform. Karl Ulrich Mayer continues to work on the German Life History Study (GLHS); further major research interests are the sociology and politics of science (pp. 269–280).



Regular art exhibitions, such as an exhibition by the Syrian artist Essam Hamdi Norrem in 2016, enrich the Institute's life.

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### **International Max Planck Research Schools (IMPRS) & Networks**

An important collaborative effort involving three of the four Centers and two of the three Max Planck Research Groups at the Institute as well as universities in Berlin, the United States, and Switzerland is the **International Max Planck Research School on the Life Course (LIFE)**. The aim is to provide advanced research training in the study of human behavior and institutional systems over evolutionary and ontogenetic time (pp. 283–287).

The **International Max Planck Research School for Moral Economies of Modern Societies (MEMS)** started in October 2013. It explores “moral economies” by identifying values, emotions, and habits that inform and inspire social formations that have emerged since the 18th century in Europe, North America, and South Asia. Research and the curriculum focus on the interlocking of new modes of feeling and the definition and justification of new social values (pp. 288–292).

The **International Max Planck Research School on Computational Methods in Psychiatry and Ageing Research (COMP2PSYCH)** started in April 2016 and is located in Berlin and London. It teaches and trains concepts and methods from computer science and statistics in relation to substan-

tive research questions in psychiatry and lifespan psychology (p. 293).

The **International Max Planck Research School on Adapting Behavior in a Fundamentally Uncertain World (Uncertainty)** integrates research in economics and psychology with a focus on cognitive and social strategies in uncertain and changing situations that involve individuals and institutions. The program extends to legal decision making and applications (pp. 294–295).

The Max Planck International Research Network on Aging (MaxNetAging) is a virtual institute for the advancement of research on the causes, patterns, processes, and consequences of aging. At its heart is the **MaxNetAging Research School (MNARS)**, a pre- and postdoctoral program that is devoted to interdisciplinary aging research. MaxNetAging also offers fellowships, research workshops, and annual conferences (p. 296). The MPI for Human Development also participates in the **Berlin School of Mind and Brain** at the Humboldt-Universität zu Berlin. The program offers a 2-year Master's degree, a comprehensive 3-year doctoral program, and postdoctoral research and career development opportunities. The focus is on the interface between the humanities and behavioral sciences with the neurosciences.

### Scientific Services

The Scientific Services at the MPI for Human Development support the individual Research Centers, their researchers, and other service units at the Institute. The **Library and Research Information Unit** (Head: Ursula Flitner) ensures rapid access to printed and electronic resources and provides comprehensive support for the efficient and independent use and dissemination of information (p. 299). The **Central IT Unit** (Head: Sebastian Lau) provides professional computing and technology support. The network, computing, and storage services enable the development and implementation of a wide range of statistical and computational methods (p. 300). The unit closely collaborates with IT experts of the various research units, keeps track of data security, and realizes data protection policies.

### Interdisciplinarity

With its diversity in methods and research orientations, the MPI for Human Development offers excellent conditions for multi- and interdisciplinary scientific exchange, both within and across its research centers and groups. In addition to specific research collaborations and occasional joint seminars, workshops, and colloquia, the Institute-wide research colloquium that was established in 2011 takes place twice a year and is attended by the entire scientific staff of the Institute.

At the colloquium, all pre- and postdoctoral researchers who are beginning the last year of their studies at the Institute present and discuss their current work.

### Teaching Activities and Academic Degrees

The Institute puts great emphasis on close collaboration with universities, including participation in teaching. Scientific staff members—directors, research scientists, postdoctoral as well as predoctoral fellows—have held seminars and lectures at German universities and abroad, for example, at the University of Basel, Berlin University of the Arts (UdK), Charité Universitätsmedizin Berlin, Freie Universität Berlin, Humboldt-Universität zu Berlin, Technische Universität Berlin, Technische Universität Dresden, University of Freiburg, Alpen-Adria-Universität Klagenfurt, Goldsmiths-University of London, Karolinska Institutet, University of Virginia, and University of Zurich. In addition, Institute members were supported by universities in Berlin and elsewhere in completing their academic degrees. In the reporting period, research staff at the Institute completed 2 habilitations and 28 doctoral dissertations. All these degrees are listed in the Appendix (pp. 301–352), which also provides lists of research colloquia, workshops, and conferences held at the Institute, and includes further information about visiting researchers and the scientific staff members.



The Institute's open spaces and communal areas encourage contact and communication.

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## Governance of the Institute

The Institute is governed by a **Board of Directors**, which consists of the members of the Institute who are Fellows (Wissenschaftliche Mitglieder) of the Max Planck Society. The Board of Directors elects one of its members to serve as the Managing Director on a rotational basis, usually for a period of 2 years. In the present reporting period, the Board consisted of the following members:

*Ute Frevert*  
*Gerd Gigerenzer* (Managing Director until 06/2014)  
*Ralph Hertwig* (Managing Director until 06/2016)  
*Ulman Lindenberger* (Managing Director as of 07/2016)

The Board is augmented by one member of the Institute's research staff (Margrit Pernau), the heads of the Max Planck Research Groups (Sven Oliver Müller [until 09/2015], Michaela Riediger [until 12/2014], Azzurra Ruggeri [as of 03/2017], Sascha Schroeder, and Annie E. Wertz [as of 01/2015]), and the head of the Administration (Brigitte Merz).

Several in-house committees, composed of representatives, either elected by the entire research staff or appointed, advise the Board of Directors on matters of scientific research and policy. One of the major institute-wide committees is the **Scientific Staff Committee** (Mitarbeiterausschuss). Furthermore, all female staff members elect an equal opportunities commissioner and her deputy. Among other things, they are involved in personnel selection procedures. Mirjam Jenny and Katja Münz are the Institute's current **Equal Opportunity Commissioners**.

The **International Board of Scientific Advisors** offers an important source of external review and advice to both the directors and the scientific staff on research matters at the Institute. Members are selected from an international circle of distinguished researchers and appointed by the President of the Max Planck Society. They meet tri-annually to discuss completed, ongoing, and future research projects at the Institute. In this reporting period, the Board consisted of the following members:

<i>Rajeev Bhargava</i>	CSDS—Centre for the Study of Developing Societies, Delhi, India
<i>Joanna Bourke</i>	Birkbeck, University of London, UK
<i>Roberto Cabeza</i>	Duke University, Durham, USA (as of 01/2015)
<i>Ido Erev</i>	Technion—Israel Institute of Technology, Haifa, Israel
<i>Andreas Gestrich</i>	German Historical Institute London, UK
<i>Reid Hastie</i>	University of Chicago, USA
<i>Matthias Kliegel</i>	University of Geneva, Switzerland (as of 01/2016)
<i>Joachim I. Krueger</i>	Brown University, Providence, USA
<i>Ruth Leys</i>	Johns Hopkins University, Baltimore, USA
<i>Mike Martin</i>	University of Zurich, Switzerland (as of 01/2015)
<i>Barbara A. Mellers</i>	University of Pennsylvania, Philadelphia, USA
<i>Denise C. Park</i>	University of Texas at Dallas, USA (until 12/2014)
<i>Patricia A. Reuter-Lorenz</i>	University of Michigan, Ann Arbor, USA (until 12/2016)
<i>Frank Rösler</i>	Universität Hamburg, Germany (until 12/2014)
<i>Hans Spada</i>	University of Freiburg, Germany
<i>Michael R. Waldmann (Chair)</i>	University of Göttingen, Germany

**Center for  
Adaptive Behavior and Cognition**

Director: *Gerd Gigerenzer*



## Research Team 2014–2016

Florian Artinger, Henry Brighton (as of 11/2016: Tilburg University, Netherlands), Uwe Czienskowski, Christin Ellermann, Flavia Filimon, Wolfgang Gaissmaier (as of 02/2014: University of Konstanz, Germany), Mirta Galesic (as of 01/2015: Santa Fe Institute, USA) **Gerd Gigerenzer**, Jana Hinneburg, Mirjam A. Jenny, Konstantinos V. Katsikopoulos (as of 03/2017: University of Southampton, UK), Monika Keller, Amit Kothiyal, Shenghua Luan, Michelle McDowell, Björn Meder, Jonathan D. Nelson (as of 02/2017: University of Surrey, Guildford, UK), Roman Prinz, Felix G. Rebitschek, Azzura Ruggeri (as of 03/2017: MPRG iSearch), Lael J. Schooler (as of 09/2014: Syracuse University, USA), Özgür Şimşek (as of 02/2017: University of Bath, UK), Laurianne Vagharchakian, Odette Wegwarth (09/2015–07/2016: Stiftung Gesundheitswissen, Berlin, Germany), Michael Zitzmann

### Postdoctoral Fellows

Pantelis Pipergias Analytis (as of 07/2016: Cornell University, Ithaca, USA), Sabrina Artinger (as of 02/2015: Federal Chancellery, Germany), Daniel Barkoczi, Stojan Davidovic, Wasilios Hariskos, Ana Sofia Morais (as of 11/2015: German Centre for Higher Education Research and Science Studies [DZHW], Berlin, Germany), Jolene H. Tan

### Predoctoral Fellows

Simón Algorta (Uncertainty), Marcus Buckmann, Hanna Bettine Fechner (MaxNetAging Research School; as of 05/2016: University of Zurich, Switzerland), Perke Jacobs, Jana B. Jarecki (as of 02/2016: University of Basel, Switzerland), Astrid Kause (01/2016–12/2016: University of Konstanz, Germany; as of 01/2017: University of Leeds, UK), Bhagyashree Padalkar (until 12/2016), Hagen Sinodoru, John Wong (MaxNetAging Research School), Charley Wu (Uncertainty)

### Adjunct Researchers

Pantelis Pipergias Analytis (Cornell University, Ithaca, USA), Sabrina Artinger (Federal Chancellery, Germany), Edward T. Cokely (University of Oklahoma, USA), Markus Feufel (Charité Universitätsmedizin Berlin, Germany), Wolfgang Gaissmaier (University of Konstanz, Germany), Mirta Galesic (Santa Fe Institute, USA), Rocio Garcia-Retamero (University of Granada, Spain), Ulrich Hoffrage (University

of Lausanne, Switzerland), Konstantinos V. Katsikopoulos (University of Southampton, UK), Astrid Kause (University of Leeds, UK), Niklas Keller (Charité Universitätsmedizin Berlin, Germany), Laura Martignon (Ludwigsburg University of Education, Germany), Marco Monti (IBM Italy), Ana Sofia Morais (German Centre for Higher Education Research and Science Studies, Berlin, Germany), Shabnam Mousavi (Johns Hopkins Carey Business School, Baltimore, USA), Jonathan D. Nelson (University of Surrey, Guildford, UK), Hansjörg Neth (University of Konstanz, Germany), Lael J. Schooler (Syracuse University, USA), Jan Gerrit Schuurman (Netherlands Enterprise Agency [RVO.nl], Assen, Netherlands), Özgür Şimşek (University of Bath, UK), Jeffrey R. Stevens (University of Nebraska-Lincoln, USA; affiliated until 09/2015), Nassim Taleb, Peter M. Todd (Indiana University, Bloomington, USA), Gregory Wheeler (Munich Center for Mathematical Philosophy, Germany; affiliated until 03/2014)

### Visiting Researchers

Giselle Appel (Columbia University, New York, USA), Nathan Berg (University of Otago, Dunedin, New Zealand), Nicolai Bodemer (University of California, Berkeley, USA), Gordon Brown (University of Warwick, UK), Anna Coenen (New York University, USA), Young Kyung Do (Seoul National University College of Medicine, South Korea), Niels Dugan (Weirarapa Hospital, Masterton, USA), Till Grüne-Yanoff (KTH Royal Institute of Technology, Stockholm, Sweden), Michaela Gummerum (Plymouth University, UK), Çağrı Haksöz (Sabanci University School of Management, Istanbul, Turkey), Yaniv Hanoch (Plymouth University, UK), Reid Hastie (University of Chicago, USA), Noboru Hidano (Tokyo Institute of Technology, Japan), Reza Kheirandish (Clayton State University, Morrow, USA), Yongfang Liu (East China Normal University, Shanghai, China), Cornelius Maurer (École normale supérieure, Paris, France), Rita Meier (RWE AG, Germany), Henrik Olsson (University of Warwick, UK), Jakob Lund Orquin (Aarhus University, Denmark), Pinar Öztop (Plymouth University, UK), Malte Petersen (FernUniversität in Hagen, Germany), Margret Anne Schoop (Jacobs University Bremen, Germany), Eric Schulz (University College London, UK), Andreas Wilke (Clarkson University, Potsdam, USA)

## Introductory Overview

The Center for Adaptive Behavior and Cognition (ABC) investigates reasoning and decision making under uncertainty in both individuals and social groups. Our research group consists of psychologists, neuroscientists, computer scientists, mathematicians, economists, engineers, and researchers from other fields. Using methodologies, such as experimental methods, computer simulation, and mathematical analysis, we cooperate in solving problems from different disciplinary perspectives. The Center's program combines a strong theoretical focus with practical applications, that is, we both develop specific models and explore their applications. Applications range from helping physicians and patients understand the statistical evidence from medical research to working with the Bank of England on developing simple heuristics for a safer, more robust financial world. These practical applications are described here in two sections, one focusing on risk literacy in health (see section on the Harding Center for Risk Literacy, pp. 185–194) and the other on decision making in the wild. Our interdisciplinary approach to studying human decision making and rationality considers three aspects: bounded, ecological, and social rationality.

### **Bounded Rationality**

Models of bounded rationality attempt to answer the question of how people with limited time, knowledge, money, and other scarce resources make decisions. With the help of such models, we study how people make—and should make—decisions in situations under “uncertainty” (where not all alternatives, consequences, and risks are known) as opposed to situations entailing known risks. This program is an alternative to the dominant optimization paradigm in cognitive science, economics, and behavioral biology, which poses the question of how a Laplacean superintelligence or near-omniscient being would behave. We study the proximal mechanisms of bounded rationality, that is, the adaptive heuristics that enable fast and frugal decisions to be made under uncertainty. This collection of heuristics and their building blocks is what we call the *adaptive toolbox*.

### **Ecological Rationality**

Models of ecological rationality describe the structure and representation of information in actual environments and their match with mental strategies, such as boundedly rational heuristics. To the degree that such a match exists, heuristics need not trade accuracy for speed and frugality: Investing less effort can also improve accuracy. A simultaneous focus

on the mind and its environment, past and present, puts research on decision making under uncertainty into an evolutionary and ecological framework, a framework that is missing in most theories of descriptive and normative reasoning. Instead of comparing human judgments to the laws of logic and probability theory, we study the adaptation of mental and social strategies to real-world environments.

### **Social Rationality**

Social rationality is a variant of ecological rationality, in which the environment is social rather than physical or technical. Models of social rationality describe the structure of social environments and their match with boundedly rational strategies that people might use. A variety of goals and heuristics exist that are unique to social environments. That is, in addition to the goals that define ecological rationality—to make fast, frugal, and fairly accurate decisions—social rationality is concerned with goals such as choosing an option that can be defended by argument or moral justification or creating a consensus. Whereas most research on bounded rationality maintains a cognitive focus, socially adaptive heuristics include, to a much greater extent, emotions and social norms that can act as heuristic principles for decision making.

## Bounded Rationality

Humans and other animals must make inferences about unknown features of their world under constraints of time, information, and other resources, such as computational capacity. Polymath and Nobel Prize winner Herbert A. Simon called the kind of rationality inherent to these tasks *bounded rationality*. In our research, the study of bounded rationality focuses on simple models, where a few pieces of information are used and processed in straightforward ways by inspecting them one at a time or simply summing them. These models describe the cognitive processes underlying a final choice or judgment precisely enough so that they can be simulated by a computer or analyzed mathematically. Just as a mechanic uses specific wrenches, pliers, and gap gauges to maintain an automobile rather than applying a hammer indiscriminately, different tasks require different specialized tools. The notion of a toolbox lacks the beauty of Leibniz's dream of a single all-purpose decision tool. Instead, it evokes the abilities of a jack-of-all-trades who can provide serviceable solutions to almost any problem with just what is at hand. This interpretation of bounded rationality provides an alternative vision to the prevailing (and contradicting) views of bounded rationality as optimization under constraints (in economics) and as a form of irrationality (in psychology).

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### Alternative Interpretations of Bounded Rationality

Paraphrasing the scientist and novelist C. P. Snow, Katsikopoulos (2014a) suggested that there are two main "cultures" of research on bounded rationality in terms of technical (e.g., data and models) and story-telling aspects (e.g., messages that can be communicated to policymakers and the public): The *idealistic culture* represents a minimal departure from the neoclassical economics framework of unbounded rationality, which assumes the ideals of omniscience and optimization of a utility function. If deviations are observed, factors such as inequity aversion or probability weighting are added to the utility function. Noble laureate Reinhard Selten has called this the "repair program." On the other hand, the *pragmatic culture* holds that people sometimes ignore information and use simple rules of thumb in order to achieve satisfactory outcomes. The story told by the idealistic culture is pessimistic: Although people should ideally be able to know what to do, they systematically fail to adhere to the supposedly normative standards of probability theory and logic. The story told by the pragmatic culture, by contrast, is more empowering: If people adaptively learn to choose the right tool from their cognitive toolbox when making decisions, they can be efficient decision makers. Gigerenzer (2016f) points out that optimization under constraints remains the dominant

interpretation of bounded rationality, even though Herbert A. Simon, who is known as the "father" of bounded rationality, explicitly dismissed this interpretation. It appears that economists and psychologists and other social scientists place a very high premium on two characteristics of optimization under constraints: (1) using all available information and (2) ensuring internal logical consistency. Without adhering to these maxims, performance will inevitably suffer in their view. Interestingly, however, recent empirical work shows that people do not conform to (1) and that not conforming to (2) is not associated with inferior performance. With respect to (1), Gigerenzer and García-Retamero (2017) used a survey instrument to test more than two thousand adults, representative of the German and Spanish population in terms of age, gender, and region. Participants were asked whether they would want to know about five negative events (e.g., "Would you want to know today when your partner will die?") and five positive ones (e.g., "Would you want to know the sex of your child before birth?"). Between 85% and 90% of people would not want to know about upcoming negative events and 40% to 70% would prefer to remain ignorant of upcoming positive events. Only 1% of participants consistently said that they wanted to know what was in store. They propose a regret theory of deliberate ignorance that covers both nega-

tive feelings that may arise from foreknowledge of negative events, such as death and divorce, and positive feelings of surprise and suspense that may arise from foreknowledge of positive events, such as knowing the sex of an unborn child. Deliberate ignorance is related to risk aversion and can be explained by avoidance of anticipatory regret. With respect to (2), Arkes, Gigerenzer, and Hertwig (2016) reviewed thousands of articles on the Web of Science and contacted judgment and decision-making researchers to request studies indicating that decision makers who fail to conform to consistency requirements, such as transitivity, are less rich, less healthy, have less accurate beliefs, and so on. They found no evidence for a causal, or even correlational, link. Does the fact that bounded rationality has not been found to lead to inferior outcomes mean that there is evidence that it leads to superior or at least equally good outcomes? A number of theoretical and empirical studies from our group support this hypothesis: There is evidence from mathematical analyses and computer simulations of models of bounded rationality and there is evidence from people—in fact, children—who exploit their bounded rationality. These two kinds of evidence are illustrated in the following two sections.

### **Bounded Rationality: From Perception to Preference and on to Inference**

The choices we make can be distinguished by two types: *preferences*, where choices are largely a matter of taste and accuracy is difficult to define and *inferences*, where the correct choices can be identified and accuracy can be assessed. Luan, Schooler, and Gigerenzer (2014) developed a boundedly rational model for the latter. The model, called  $\Delta$ -inference, is a generalization from a known preference model, lexicographic semiorders, to inference tasks. In a paired-comparison inference task, which entails choosing which of two objects has a larger criterion value based on a set of cues, the model can be described by the following three building blocks:

(1) *Search rule*: Examine cues in the order of their accuracy (e.g., correlation with the

criterion), where accuracy is assessed for each cue independently from the other cues.

(2) *Stopping rule*: If the difference between two objects, A and B, exceeds a threshold value  $\Delta$  on a cue, then stop search.

(3) *Decision rule*: If the cue is positively related to the criterion, infer that the object with the higher cue value is the one with the higher criterion value; otherwise, infer that the object with the lower cue value is the one with the higher criterion value. If no difference exceeds  $\Delta$  for all cues, then pick one object by guessing.

Key to the model and its performance is the threshold parameter  $\Delta$ . Guided by Clyde Coombs' theory of single-peaked preference functions, Luan et al. (2014) showed that the accuracy of  $\Delta$ -inference can be understood as an approach-avoidance conflict between the decreasing usefulness of the first cue and the increasing usefulness of subsequent cues as  $\Delta$  grows larger, resulting in a single-peaked function between accuracy and  $\Delta$ . The peak of this function varies with the properties of the task environment: The more redundant the cues are and the larger the differences in their information quality, the smaller is the  $\Delta$ .

In well-defined simulated task environments, the  $\Delta$  that leads to the highest accuracy, denoted as *Peak  $\Delta$* , is usually an intermediate value. However, when tested in 39 natural data sets, the *Peak  $\Delta$*  is on average much smaller. Moreover,  $\Delta$ -inference with *Peak  $\Delta$*  has, on average, the same predictive accuracy as  $\Delta$ -inference with  $\Delta = 0$  (see Figure 1). The latter implies that the model relies almost exclusively on the best cue to make inferences and ignores all other cues, similar to the take-the-best heuristic. Finally, Luan et al. (2014) also tested how different  $\Delta$ -inference models fared against other models of inference in the natural data sets. As shown in Figure 1, linear regression is more accurate in fitting, but much less accurate in prediction. Two other benchmark models, Bayesian linear regression and the general monotone model (GeMM), could not outperform the  $\Delta$ -inference models unless the learning sample was comparatively large.

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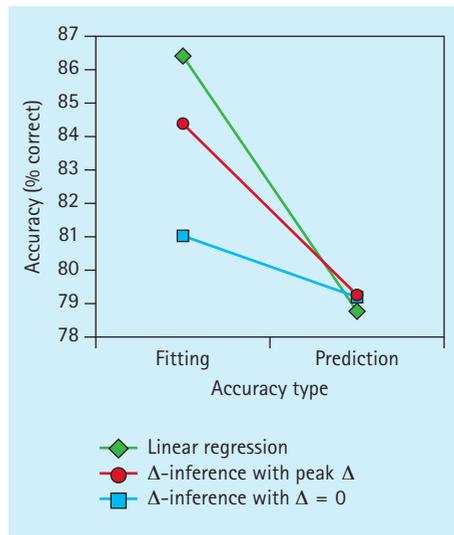


Figure 1. The fitting and predictive accuracy of linear regression and two  $\Delta$ -inference models in paired-comparison inference tasks, averaged across 39 natural data sets from diverse fields, such as economics, psychology, biology, transportation, and engineering. Whereas linear regression outperforms the two  $\Delta$ -inference models in fitting, the  $\Delta$ -inference models perform slightly better in prediction. Note that  $\Delta$ -inference with  $\Delta = 0$  implies that all decisions are made by the first cue searched, except for those in which the cue values of the two objects are tied on the first cue and the search must continue to the next cue or cues (adapted from Luan, Schooler, & Gigerenzer, 2014).

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This work demonstrates that integrating and extending established concepts, models, and theories from perception and preference can improve our understanding of how the mind makes inferences. It also shows that in real-world environments, one can make good inferences by searching for very little information and spending little thought on selecting the best  $\Delta$  because a  $\Delta$  of 0 is generally good enough.

### Children Can Perform Well By Exploiting Their Bounded Rationality

Almost by definition, children are boundedly rational. They lack many of the computational resources that adults have at their disposal and possess much less knowledge about the world. To learn about their physical and social environments, children constantly acquire new information from an early age on. Infants spontaneously grab and manipulate objects,

and approach or avoid people. As language develops, young children inquire about the meaning of words, the names of objects, and the many other new and puzzling phenomena they encounter. Research shows that children's explorative actions, question asking, and free play are crucial for learning about the world. But how effective is children's information search? And do children adapt their search behavior to the characteristics of the task at hand?

Nelson, Divjak, Gudmundsdottir, Martignon, and Meder (2014) investigated which boundedly rational strategies children use for selecting among a set of given questions. Sixty 8- to 10-year-olds played the popular *Guess Who* game, a variant of the 20-questions game. They were presented with 18 cards, each representing a person's face (Figure 2, left). Their task was to identify a target face card, randomly selected, by asking as few yes-no questions about the faces' features (e.g., gender, beard) as possible. If the children needed help formulating a question, they could refer to 20 available questions (physical features).

Figure 2 (right) shows how a simple heuristic strategy, the *split-half heuristic*, would play the game. The split-half heuristic always selects the feature that comes closest to being possessed by half of the faces remaining. For example, if the randomly selected target face is Victor's, then the split-half heuristic would first query about the feature "male" (the answer would be yes), then "beard" (the answer would be no), followed by "big mouth" (the answer would be yes), and finally "white hair" to identify him. Importantly, it can be proven that in *Guess Who* the split-half heuristic always chooses the highest information-gain question, that is, the question with the highest expected reduction in Shannon entropy. Moreover, it can be shown analytically that the split-half heuristic performs optimally in the particular environment (statistical distribution of features; see Figure 2), where the optimality criterion is to minimize the expected number of questions. Despite their young age, the children tested by Nelson et al. (2014) performed well in the game, making use of the heuristic in good measure. For

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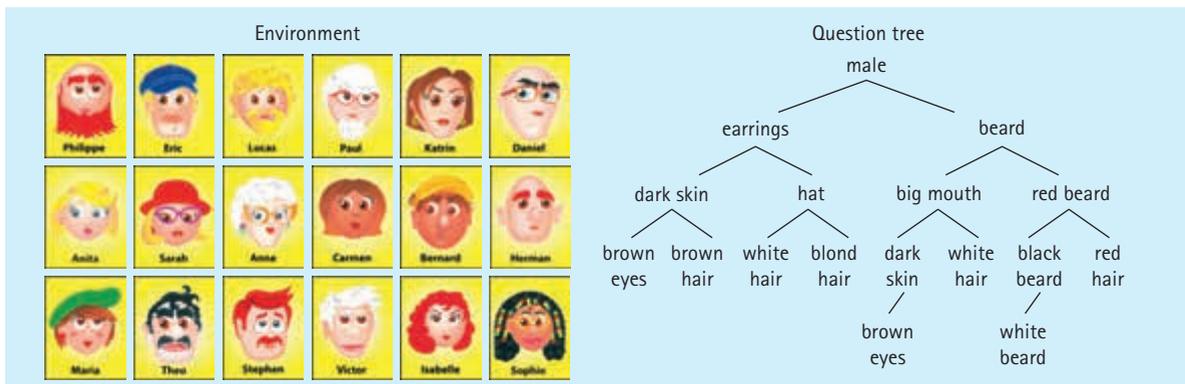


Figure 2. In the *Guess Who* game, the player is presented with a set of face cards and has to identify which of them has been selected randomly. The goal is to ask as few yes–no questions about the face's features (e.g., gender, beard) as possible. The split-half heuristic always queries about the feature that comes closest to being possessed by half of the remaining faces. In this example, if the card selected shows Victor, the heuristic would identify him by making queries about the features "male," "beard," "big mouth," and "white hair." We thank Hasbro Germany for permission to use and reproduce the stimuli from their *Wer ist es?* (*Guess Who*) game (adapted from Nelson, Divjak, Gudmundsdottir, Martignon, & Meder, 2014).

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example, the gender (male/female) question was asked first by the children in 55% of all trials. By contrast, in a different environment (different set of cards), in which gender was not the best first question, only 24% of first queries referred to that feature.

Converging findings come from Ruggeri and Lombrozo (2015), who investigated how children (7- and 10-year-olds) and young adults adapt their question-asking strategies to different characteristics of the problem at hand. Their results revealed that even young children dynamically change the types of questions they rely on in response to the information structure of the task, such as the number and a priori probability of the considered hypotheses, the difficulty of the solution to be found, and the feedback received from previous questions.

Further evidence for children's adaptive search behavior comes from developmental studies by Ruggeri, Lombrozo, Griffiths, and Xu (2016), who conducted two studies to identify potential sources of developmental change in how 7-year-olds, 10-year-olds, and adults search for information. Presented with 16 objects (e.g., animals and plants), participants could either ask questions (Study 1) or select individual

objects (Study 2) to discover which category of objects within a nested structure (e.g., animals, birds, or owls) had a novel property (e.g., is present on Planet Apres). After receiving feedback, participants could choose whether to conduct another query or to guess the solution, with the goal of finding the solution with as few queries as possible.

The results demonstrate developmental improvement in the effectiveness of information search. Importantly, the results also revealed a previously undocumented source of developmental change: Children are more likely than adults to continue their search for information beyond the point at which a single hypothesis remains and thus to ask unnecessary questions. This suggests that one crucial source of developmental change in information search effectiveness lies in children's acquisition of "stopping rules," a key building block of heuristics. Looking for confirming evidence could indeed be prudent when there is uncertainty about the hypothesis space, the obtained feedback, or the constancy of what is being learned. As novice learners in a noisy and uncertain world, children might be better to err on the side of caution by obtaining extra feedback.

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## Ecological Rationality

The performance of a decision strategy, be it a simple heuristic or a complex model, depends on the structure of the environment in which it is applied. We study this relationship systematically by specifying formal models of simple and complex decision-making rules. The research program on ecological rationality aims at characterizing the structure of environments and understanding the fit between these structures and the performance of decision models. Performance is measured by external criteria, such as frugality (amount of information considered) and predictive accuracy (how well the model predicts unseen data). This approach differs strongly from the study of logical rationality, where performance is measured by internal criteria, such as consistency with mathematical axioms.

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### Decision Heuristics Compete Well With Statistical Techniques

Decision heuristics use few pieces of information—sometimes only a single piece of information—and integrate these in simple ways. For example, *single-cue heuristics* use a single piece of information, *lexicographic heuristics* consider the pieces of information sequentially, and *tallying* weights the different pieces of information equally.

How well can such simple methods compete with complex statistical techniques in terms of predictive accuracy? To answer this, Şimşek and Buckmann (2015) conducted an empirical analysis in a large, diverse collection of natural environments. They compared decision heuristics with two considerably more complex statistical methods: logistic regression (with elastic-net regularization) and decision trees (induced by CART). Their analysis is the most extensive evaluation of decision heuristics to date, employing 63 natural data sets on various subjects gathered from diverse sources, including online data repositories, textbooks, statistical software packages, statistics and data mining competitions, research publications, and individual scientists' collections of field data. These data sets varied in subject, size, and the amount of information available for making a decision. The decision problem was paired comparison, where the objective was to identify which of two alternatives has the higher value on a specified (unobserved) criterion: for example, to identify which of two houses currently for sale will return a higher yield on investment in 10 years, given their age, location, lot size, and sale price.

Figure 3 shows the mean learning curves for various decision methods. Each model's pa-

rameters were learned from training examples, where one training example comprised a single paired comparison between two objects in the data set. The horizontal axis shows the number of training examples used, which ranged from 1 to 100. The vertical axis shows the predictive accuracy of the various models, that is, the accuracy of the models on paired comparisons that had not been used to train the models. All training and test examples were independent of each other.

The single-cue heuristic learned the identity of the cue to be used, while the lexicographic model learned how the cues should be ordered. In addition, all three heuristics learned *cue directions*, that is, whether each piece of evidence is positively or negatively related to the criterion. As the figure shows, despite their computational simplicity, heuristics competed remarkably well with the more complex statistical models. In early parts of the learning curve, tallying was the best-performing model on average. Later on, the lexicographic decision rule either performed best or trailed the best-performing model very closely. Furthermore, the single-cue heuristic performed surprisingly well, trailing the lexicographic heuristics by 1.6 percentage points or less.

Şimşek and Buckmann (2015) also analyzed the learning rate of heuristics theoretically to discover how much computation and how many training examples were required to learn effective heuristics. Because of their simplicity, heuristics require a very small amount of computation at decision time. Like all statistical models, however, they have free parameters that are learned from training examples, such as cue directions. For that

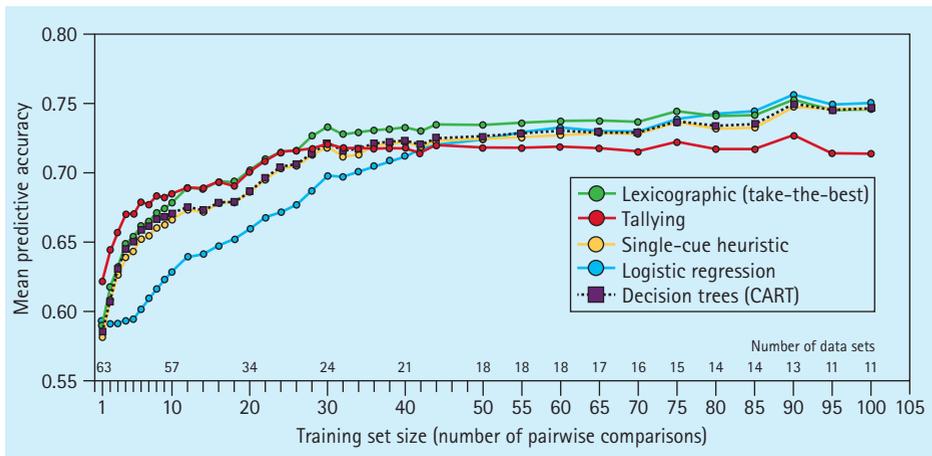


Figure 3. Performance of three decision heuristics compared to logistic regression (with elastic-net regularization) and decision trees (induced by CART) in a large, diverse collection of natural environments. Tallying predicts best with a small training set (up to 10 training examples); take-the-best predicts best with intermediate training set sizes; all models (except for tallying) predict about equally well for the largest training set sizes. Less can be more (adapted from Şimşek & Buckmann, 2015).

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reason, it was speculated in the scientific literature that the computational requirements of learning effective heuristics might in fact be high.

The authors theoretically examined two building blocks of learning heuristics: assigning cue direction (i.e., determining whether the cue is positively or negatively related to the criterion) and determining which of two cues has the higher predictive accuracy. Their analysis showed that even a few training examples lead to substantial progress in learning both building blocks. For example, if cue direction is assigned after a single training example, the expected accuracy of the cue is at least 83% of the accuracy obtained based on the true cue direction.

### Statistical Properties of Natural Environments Support Decision Heuristics

How can we explain the remarkable performance of simple decision rules? For one, all decision models err when making predictions. From a statistical perspective, a model's prediction error results from bias, variance, and noise: total prediction error = (bias)<sup>2</sup> + variance + noise. The bias component reflects the inability of a model to represent the systematic patterns within the data, while the

variance component reflects the sensitivity of the model's predictions to different training examples for the same decision problem. For some time, it was believed that heuristics achieve low prediction error mainly by achieving relatively low variance, which compensates for their relatively high bias. Şimşek (2013), however, suggested that the structure of natural environments may be such that within them simple heuristics are able to achieve a level of bias comparable to that of more complex models. Recently, Gigerenzer (2016i) echoed this surprising hypothesis in his contribution to a volume commemorating the centennial of Herbert A. Simon's birth. Simple and cumulative dominance are two environmental structures that allow heuristics to achieve a level of bias equal to that of any linear model, including unit-weights regression, ordinary least-squares regression, or even state-of-the-art regularized linear regression. Consider a decision problem with three cues,  $C_1$ ,  $C_2$ , and  $C_3$ , where a larger value is more desirable for each of the cues. Decision alternative  $A$  with cue profile (3, 3, 4) is said to *simply dominate* decision alternative  $B$  with profile (1, 2, 0) because  $A$  has higher values than  $B$  on each of the cues. In addition,  $A$  is said to *cumulatively dominate* decision

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alternative  $C$  with cue profile (1, 4, 0) because the cumulative profile of  $A$ , (3, 3 + 3 = 6, 3 + 3 + 4 = 10) dominates the cumulative profile of  $C$  (1, 1 + 4 = 5, 1 + 4 + 0 = 5), given cue order  $C_1$ ,  $C_2$ , and  $C_3$ . The existence of a simply or cumulatively dominating option means that simple heuristics, such as take-the-best, can achieve equal bias with any linear model, regardless of its complexity. Şimşek (2013) has shown that both simple and cumulative dominance are prevalent in natural environments when the decision task is paired comparison. Katsikopoulos, Egozcue, and Fuentes Garcia (2014) presented a detailed analysis of the prevalence of cumulative dominance by using computer simulations, where decision problems with two options and 2 to 10 continuous cues were generated, with cue values sampled from a range of probability distributions, including uniform, normal, and skewed distributions. The prevalence of cumulative dominance was higher when the number of cues was smaller. For 10 cues, cumulative dominance occurred in 35% of the decision problems; for less than 5 cues, cumulative dominance occurred in the majority of problems, reaching 75% for 2 cues. In addition, Katsikopoulos and colleagues showed analytically that, if a dominating option exists, take-the-best and other simple heuristics achieve equal bias to that of any linear model that also includes multiplicative interactions among any subset of the available cues.

The results discussed so far relate to one-shot paired comparison problems. More recently, Şimşek, Algorta, and Kothiyal (2016) showed that the prevalence of dominance relationships is likely to extend to a much more difficult class of problems known as *sequential decision problems under uncertainty*. One example is the popular computer game Tetris. Tetris is played on a two-dimensional grid that is initially empty. Game pieces called *tetriminos* fall from the top of the grid one at a time, piling up on each other. Each tetrimino occupies four cells and is one of seven different shapes. As each tetrimino falls, the player controls where and how it lands by rotating it and moving it horizontally in either direction or

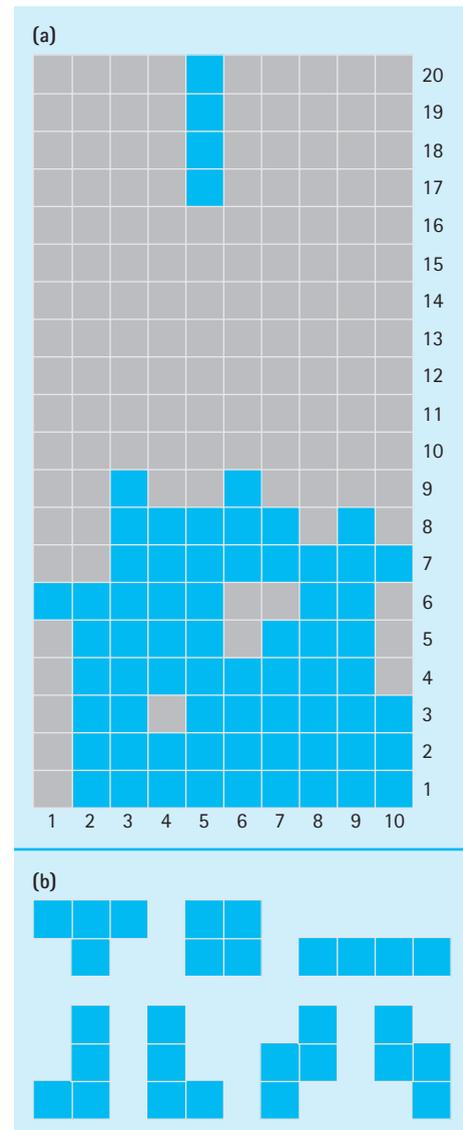


Figure 4. Sample board during a game of Tetris, showing a tetrimino falling from the top of the grid (a) and the seven possible tetriminos (b) (adapted from Şimşek, Algorta, & Kothiyal, 2016).

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filled, it is deleted, creating additional space on the grid. The game ends when there is no space remaining at the top of the grid for another tetrimino. Figure 4 shows the Tetris board during a game, with a tetrimino falling from the top of the grid (upper panel), and the seven possible tetriminos (lower panel). Artificial players can learn to play Tetris very proficiently, removing hundreds of thousands

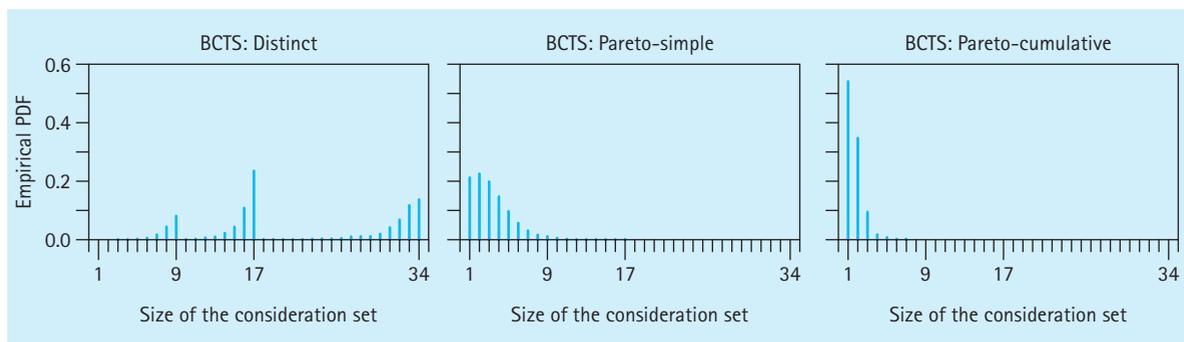


Figure 5. The empirical distribution of the number of decision alternatives (placements of the falling tetrimino) while playing Tetris: number of decision alternatives that Building Controllers for Tetris Systems (BCTS) views as distinct (left panel), number of decision alternatives remaining after filtering by simple dominance (middle panel), and number of decision alternatives remaining after filtering by cumulative dominance (right panel) (adapted from Şimşek, Algorta, & Kothiyal, 2016).

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of rows. One of the best-known artificial players is called Building Controllers for Tetris Systems (BCTS). BCTS estimates the value of each placement—defined by where and in what orientation to land the falling tetrimino—by using a linear evaluation function of eight cues. For example, one of the eight cues is the total number of holes that would be present on the board with the given placement.

Figure 5 shows the prevalence of simple and cumulative dominance in Tetris. Three empirically derived probability distributions are shown. The left panel shows the number of placements that are legal and distinct according to BCTS; that is, BCTS assigns a different evaluation score to each of these placements. The median value is 17. The middle panel shows the number of placements that are not simply dominated by one or more other placements (called *Pareto-simple*). Here, the median value is 3. Finally, the right panel shows the number of placements that are not cumulatively dominated by one or more other placements (called *Pareto-cumulative*). The median value is 1. Taking into account the mathematical truth that the best placement in the set “distinct” (according to BCTS) is also the best in Pareto-simple and Pareto-cumulative sets, one can substantially reduce the number of placements that need to be considered when filtering the action set by simple and cumulative dominance. When filtered by cumulative dominance, the median size of the

consideration set is reduced from 17 to 1. This means that, in most cases, where only one placement remains in the consideration set, the need to make a decision is eliminated. Şimşek et al. (2016) also showed how algorithms in machine learning can exploit simple and cumulative dominance to learn more efficiently, using a much smaller number of training examples. Whether dominance relationships are prevalent in sequential decision problems other than Tetris remains an open question. If so, it should be possible to train machine learning algorithms much more efficiently by taking this property into account. The research on sequential decision problems and Tetris demonstrates how ideas and concepts from research on the ecological rationality of simple heuristics can be applied to areas beyond psychology and cognitive science (see also section on “Decision making in the wild”). Thanks to the interdisciplinary background of the researchers in our group, ideas, such as the bias–variance decomposition of prediction error and dominance relationships among decision alternatives, have been discussed and applied to other fields. For instance, Katsikopoulos and Syntetos (2016) discuss the conceptual and methodological implications of the bias–variance decomposition in the context of forecasting in business. Typically, statistical methods for forecasting a quantity, say the demand of a product by a supply chain manager, are evaluated solely by their bias. Katsikopoulos and Syntetos (2016)

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highlight the importance of taking a method's variance into account as well. Interestingly, in the context of forecasting, controlling variance can be doubly important because inventory and delivery systems may be overburdened by outliers that had not been predicted. Brighton and Gigerenzer (2015) define the concept of the *bias bias*, which is the pervasive tendency to evaluate a human judgment or the output of a model, mostly based on its bias, while ignoring its variance. This tendency is exhibited by laypeople, but perhaps even more so by experts and researchers.

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### Diagnostic Reasoners Take Into Account Uncertainty About the Structure of the Environment

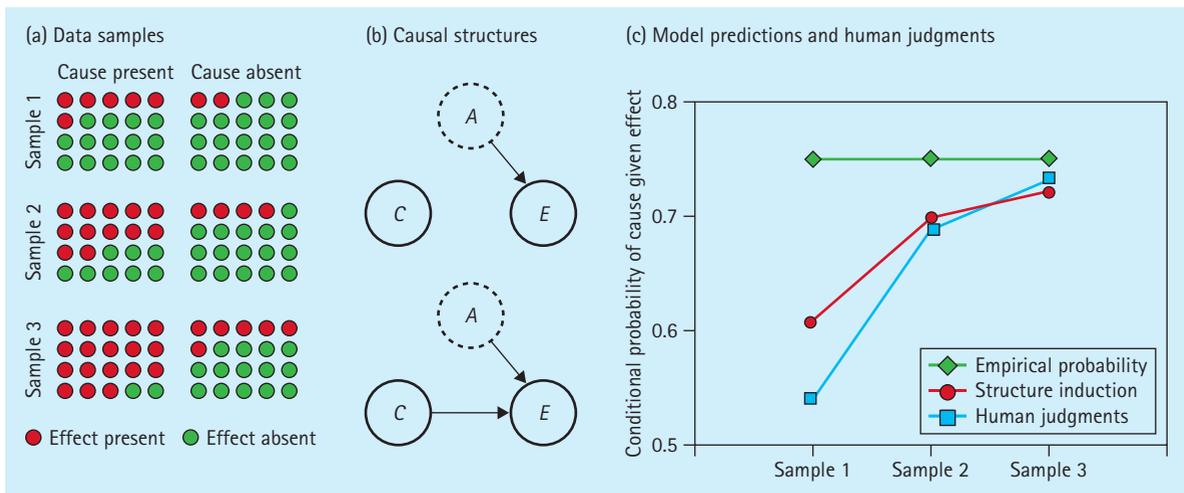
The previous sections discussed how the behavior of simple and complex models is contingent on environmental structures. This section considers the role of the causal structure of the environment in human reasoning and decision making.

How do people make diagnostic inferences from effect to cause? How does the mind adapt to uncertainty about the structure of the environment when reasoning diagnostically? The long-standing normative benchmark for diagnostic inferences is Bayes' rule applied to the empirical data or verbally described statistics. In an uncertain world, however, inferences often have to be made based on limited and noisy data samples from the environment. Meder, Mayrhofer, and Waldmann (2014; Meder & Mayrhofer, 2017) argue that a purely statistical norm like Bayes' rule applied to the observed data is not an adequate normative benchmark for rational inference because it neglects alternative causal structures that may have generated the data. They instead propose the *structure induction model of diagnostic reasoning*, which formalizes the intuition that diagnostic inferences should take into account whether the sample data warrant the existence of a causal relation between the candidate cause and the effect or not.

Consider the case of a possible causal relation between a binary candidate cause, such as having a particular genetic predisposition, and a potential binary effect, such as having

elevated blood pressure. A sample of data is available, that is, a joint frequency distribution that specifies for each person in the sample whether they have the condition or not (cause present vs. absent) and whether they have elevated blood pressure or not (effect present vs. absent). Examples of three data sets are shown in Figure 6a. Each sample comprises 40 people: 20 with the genetic predisposition and 20 without. In each sample, the proportion of people with elevated blood pressure varies. In Sample 1, 6 out of the 20 people with the predisposition have elevated blood pressure, whereas only 2 out of 20 people without it have elevated blood pressure. The corresponding numbers for Sample 2 are 12 out of 20 compared to 4 out of 20; for Sample 3, they are 18 out of 20 versus 6 out of 20. Importantly, the diagnostic probability of cause given effect is identical across the three data sets: In each sample, 75% of people who have elevated blood pressure possess the genetic predisposition.

Assume that a new person from the same reference class is drawn at random. This person has elevated blood pressure: What is the probability of that person also having the genetic predisposition? A purely statistical model such as Bayes' rule applied to the observed data predicts that this probability is 0.75. The structure induction model, by contrast, makes very different predictions by taking into account uncertainty about the structure of the environment. For the case of a single cause and a single effect, the model considers two alternative causal structures that may underlie the data (see Figure 6b). According to the first structure, *C* and *E* are independent events; that is, there is no causal relation between them. Although there may be a statistical dependency in the sample data (e.g., people with the predisposition are more likely to have elevated blood pressure than those without), this co-occurrence is merely accidental, and the effect is exclusively generated by unobserved (independent) background causes *A*. By contrast, the alternative environmental structure (see Figure 6b bottom) states that there is a causal relation between *C* and *E* (and also alternative background causes *A* that can



**Figure 6.** How the structure induction model of diagnostic reasoning works. (a) Three different data samples. In each sample, the diagnostic probability of cause given effect is 0.75. (b) Alternative environmental structures that may underlie the observed data. According to the upper structure, candidate cause *C* and effect *E* are independent; any observed empirical contingency is merely coincidental. According to the alternative structure (bottom) there is a causal relation between *C* and *E*. (c) Model predictions and empirical results. Because the empirical probability of cause given effect is 0.75 in all three data samples, a purely statistical account predicts the same judgment for each data set. The structure induction model makes very different predictions by taking into account uncertainty about environmental structure. It predicts higher judgments as it becomes more likely that the data warrant the existence of a causal relation. Mean human judgments are not invariant across the three data sets, showing that people are sensitive to uncertainty about environmental structure (adapted from Meder, Mayrhofer, & Waldmann, 2014).

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independently generate the effect when *C* is absent).

The structure induction model predicts that the observation of the effect should lead to higher diagnostic inferences the stronger the belief is in the existence of a causal relation between the candidate cause and effect. Thus, even if an identical probability of the disease given the symptom is observed in different data sets, this does not necessarily mean that the diagnostic judgments are invariant. Figure 6c illustrates these predictions for the three data sets shown in Figure 6a. Because the empirical probability of cause given effect is identical across all data sets, a purely statistical account predicts that diagnostic judgments are invariant. The structure induction mode, however, predicts diagnostic probabilities that systematically deviate from the observed probabilities. For instance, for Sample 1, the empirical probability of cause given effect is 0.75, whereas the structure induction model predicts a conditional prob-

ability of 0.61. This prediction arises from the fact that the contingency between cause and effect is relatively weak, so that either of the two structures has equally likely generated the data.

Is human diagnostic reasoning sensitive to uncertainty about the structure of the environment? Meder et al. (2014) presented participants with different data samples in which the empirical diagnostic probability was invariant (as in the three data sets in Figure 6a, where the diagnostic probability was always 0.75) and asked them to make a diagnostic judgment from effect to cause. The key finding was that human diagnostic judgments systematically varied (see Figure 6c). Although such an inference pattern appears flawed and biased from the perspective of a purely statistical account, the analyses show that the judgment patterns should instead be considered as resulting from a causal inference strategy that is well adapted to the uncertainties of the world.

## Social Rationality

How do humans cope with a world full of uncertainty? One way is to apply mental tools that are boundedly and ecologically rational, such as simple heuristics; another is to exploit the collective wisdom arising through communication and social interactions. Understanding how humans make judgments and decisions in interactive, social environments has always been a key goal of the Center. In line with our work on other research topics, we study social rationality by focusing on the interplay of the mind—or a group of minds—and the environment, exploring how simple strategies help us solve difficult social problems and investigating the conditions under which collective decisions succeed or fail. The research reported here covers recent work in the areas of crowd wisdom, creativity, moral judgment, cooperation, and social cognition and learning.

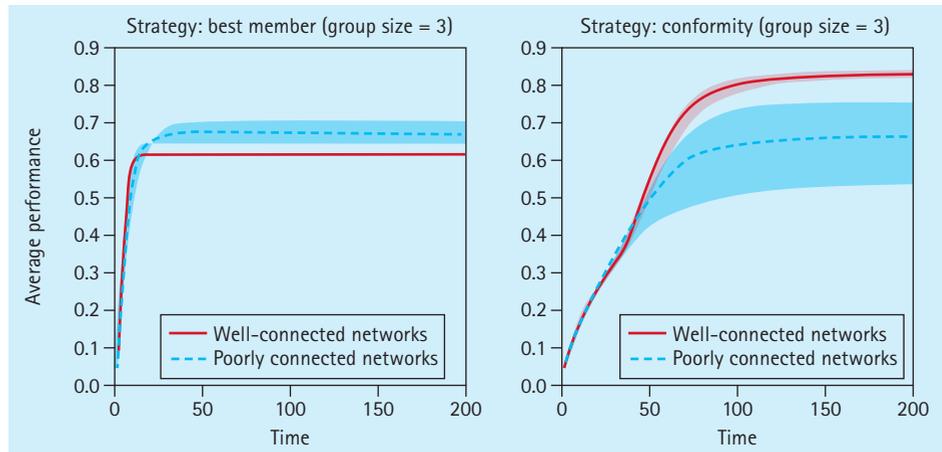
### Key Reference

**Barkoczi, D., & Galesic, M.** (2016). Social learning strategies modify the effect of network structure on group performance. *Nature Communications*, 7:13109. doi:10.1038/ncomms13109

### How Do Social Networks Influence Group Performance?

The structure of social networks is an important factor determining the problem-solving capacity of teams, organizations, and societies. However, previous studies yielded contradictory results regarding the relationship between network structure and group performance: Some showed support for the superior performance of well-connected, efficient network structures, whereas others showed support for that of poorly connected, inefficient network structures. Barkoczi and Galesic (2016) hypothesized that the influence of social networks on group performance depends on both the network structure and

the social learning strategies used by individual team members. Consequently, reliance on different social learning strategies can lead to the superiority of either well-connected or poorly connected network structures. To test this hypothesis, the authors conducted a simulation study in which a group of agents performed a problem-solving task. To obtain good solutions, the group had to strike a balance between exploration (i.e., searching for new solutions through trial and error) and exploitation (i.e., imitating existing solutions that work well). The authors varied a number of factors, including task difficulty, individuals' social learning strategies, and network structures. As Figure 7 shows, well-connected



*Figure 7.* Group performance over time. Group performance is the average performance over either 10 well-connected (red solid lines) or 10 poorly connected (blue dashed lines) networks. Left panel: groups relying on the best member strategy (i.e., copying the solution from the highest payoff member); right panel: groups relying on the conformity strategy (i.e., copying the most frequent solution within the group). Shadings around the lines show the region between the best and worst performing network in each category at each point in time. The results demonstrate that well-connected networks are superior when individuals rely on the conformity learning strategy, whereas poorly connected networks are superior when individuals copy the best member (adapted from Barkoczi & Galesic, 2016).

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networks were found to outperform poorly connected networks when individuals relied on conformity by copying the most frequent solution among their social contacts. However, poorly connected networks were superior when individuals copied the group member with the highest payoff. The intuition underlying these results is that both network structure and social learning strategy affect the balance of exploration and exploitation and that a group needs to find a good match between the two to perform well. Overall, their findings reconcile contradictory results in the literature and highlight the importance of studying the match between

cognition (social learning strategy) and the environment (social network structure) in group decision research.

### Smaller Crowds Can Be Wiser

Decisions about political, economic, legal, and health issues are often made via simple majority voting by groups that rarely exceed 30 to 40 members and are typically much smaller. Given that wisdom is usually attributed to large crowds, should committees not be larger? Galesic, Barkoczi, and Katsikopoulos (2016) studied this question using a simple mathematical model. They assumed that, over the course of their

### Key Reference

Galesic, M., Barkoczi, D., & Katsikopoulos, K. V. (2016). Smaller crowds outperform larger crowds and individuals in realistic task conditions. *Decision*. Advance online publication. doi:10.1037/dec0000059

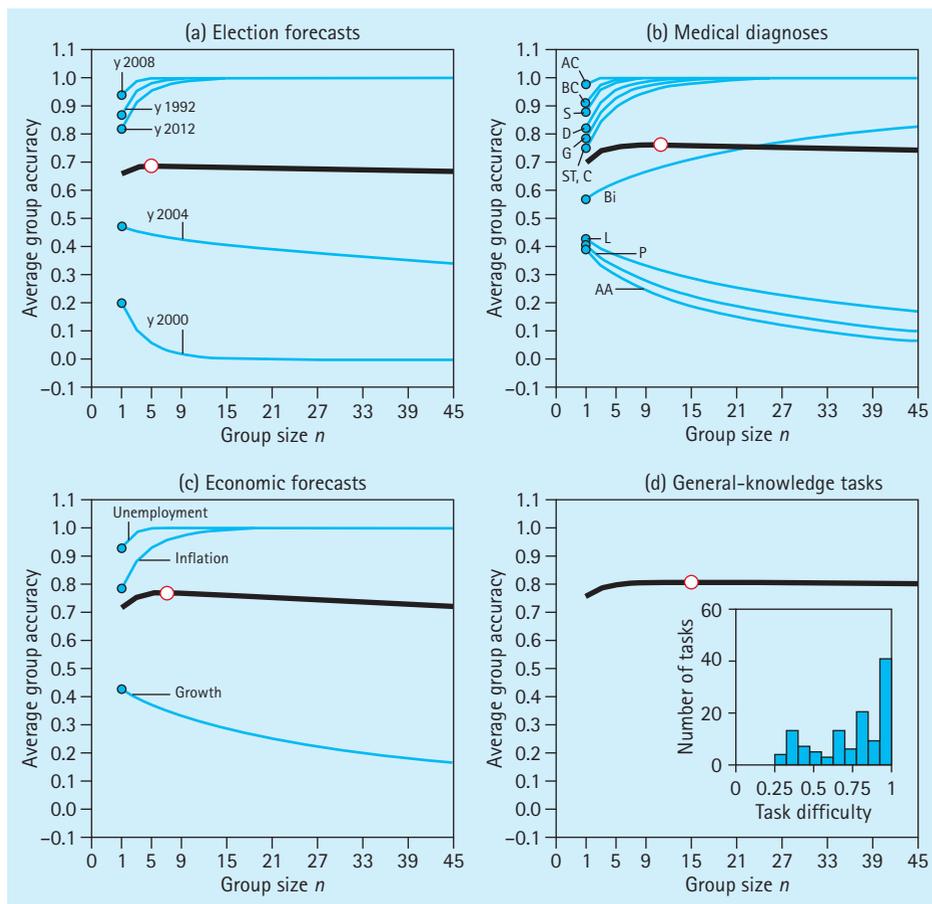


Figure 8. Average group accuracy depends on the combination of task difficulties and the proportion of easy tasks a group encounters. Using data on expert forecasting accuracies for different events in four different domains (panels a–d), the authors derive the best group size. Blue lines show extrapolated accuracy for each task, assuming different group sizes; black lines show average group accuracy across all tasks. Given the large number of trials available in panel d, the blue lines are replaced by a histogram showing the distribution of task difficulties. In all four domains, small to moderate-sized groups achieve greatest accuracy (adapted from Galesic, Barkoczi, & Katsikopoulos, 2016).

## Key Reference

Fific, M., & Gigerenzer, G. (2014). Are two interviewers better than one? *Journal of Business Research*, 67, 1771–1779. doi:10.1016/j.jbusres.2014.03.003

existence, groups can encounter a number of different tasks. Most tasks are easy, where average individual accuracy is above chance (i.e., most individuals are more likely to be correct than incorrect), but some are surprisingly difficult, where most group members decide wrongly. Examples of such tasks are elections with surprising outcomes, sudden turns in financial trends, or tricky knowledge questions. It is difficult, if not impossible, for groups to predict in advance whether the next task will be easy or difficult. The authors show that, under these circumstances, moderately sized groups, whose members are selected randomly from a larger group, can achieve higher average accuracy across all tasks than can either larger groups or individuals. This occurs because an increase in group size can lead to a decrease in group accuracy for difficult tasks that is larger than the corresponding increase in accuracy for easy tasks. The authors derive this nonmonotonic relationship between group size and accuracy from the Condorcet jury theorem and use simulations and further analyses to show that it holds under a variety of assumptions. They further show that situations favoring moderately sized groups occur in a variety of real-life situations, including political, medical, financial decisions, and general knowledge tests (see Figure 8). These results have implications for the design of decision-making bodies at all levels of policy.

## Are Two Interviewers Better Than One?

When firms hire candidates for job positions, the final decision is often based on a series of interviews. How many interviewers should be used for each candidate to achieve the best results? Condorcet's jury theorem and the "wisdom of the crowd" suggest that more is better. In fact, a survey showed that large consulting firms use between 5 to 11 different interviewers per candidate, depending on the level of the position. Questioning this practice, Fific and Gigerenzer (2014) show that—under quite general conditions—two interviewers are on average not superior to the best interviewer. Nor will adding further interviewers increase the expected collective hit rate when interviewers are homogeneous (i.e., their hits are nested), but only when interviewers are heterogeneous (i.e., their hits are not nested).

Consider a company that wants to identify the 10 best applicants ("targets") out of a pool of 100. The interviewers are called "Interviewer 1, 2, ..., " where "1" stands for the interviewer with the best hit rate, "2" for the second best, and so on. All decisions are made by the majority rule. Under these conditions, Fific and Gigerenzer (2014) showed that using Interviewer 1 alone is always better than adding Interviewer 2; that is, one interviewer is better than two. For instance, if Interviewer 1 has a hit rate of 0.80 and gets to pick 10 out of a pool of 100 applicants, we expect that interviewer to pick 8 of the 10 targets. Adding

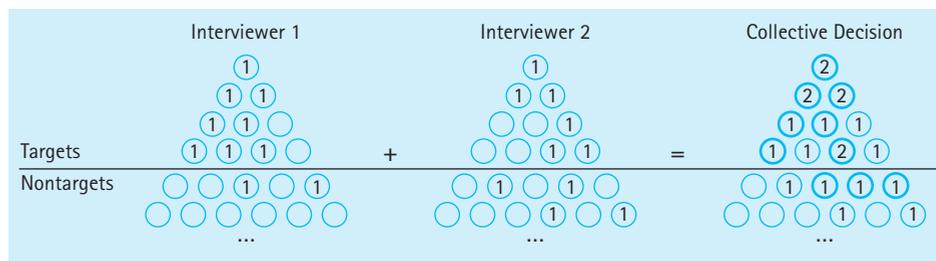


Figure 9. Does it help to add Interviewer 2, who is able to identify all targets that Interviewer 1 missed? The 10 target candidates (circles) are placed at the pyramid's top. The best interviewer, Interviewer 1, has a hit rate of 0.80 (i.e., selecting 8 of the top 10 candidates ["targets"] correctly). Interviewer 2 has a lower hit rate of 0.60, but picks the two targets that the other interviewer misses. The two interviewers' collective decision is made by the majority rule; that is, they choose the ones who receive two votes and randomly select the ones who receive one vote (the number of votes is noted in the circles). The expected collective decision is shown on the right side of the figure with the selected candidates in bold circles. The hit rate of the collective decisions is only 0.70, lower than when relying on the best interviewer alone (adapted from Fific & Gigerenzer, 2014).

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another interviewer with a lower hit rate (e.g., 0.60) will, on average, result in a lower hit rate than using Interviewer 1 alone. This holds even if Interviewer 2 can correctly identify all targets that Interviewer 1 missed, as illustrated and explained in Figure 9.

What happens if the company wants to use a team of interviewers with  $n > 2$  members? Fific and Gigerenzer (2014) showed that a homogeneous set of  $n$  interviewers will never be better than the best interviewer alone nor will there be any improvement by having "mirror" interviewers who can identify the targets missed by the best interviewer. If the best interviewer is not known, it will be better for a company to hire a team of heterogeneous interviewers. The size of this team depends on the range of individual hit rates: The closer the hit rates to that of the best (unknown) interviewer and the smaller their variability, the fewer additional interviewers are needed.

This analysis has significant implications on hiring practice. First, it suggests that the best policy is to invest resources in improving the quality of the best interviewer rather than

distributing these to improve the quality of many interviewers. Second, in cases where it is unclear who the best interviewers are, companies should increase the size of the interviewing team and draw on heterogeneous interviewers with diverse backgrounds.

### The Power of Groups in Developing Good Ideas

Research on brainstorming has repeatedly claimed that individuals are more creative than groups. However, these conclusions are largely based on measuring creativity by the quantity of ideas generated. Other important components of creativity, such as the development of initial ideas, are often ignored. Given the topic's great practical relevance, there is a need for more empirical studies that can capture the complexity of the entire creative process and investigate whether the development of an idea is best achieved in a group setting or individually.

McMahon, Ruggeri, Kämmer, and Katsikopoulos (2016) compared group performance with individual performance in creative tasks beyond the idea generation phase,

### Key Reference

McMahon, K., Ruggeri, A., Kämmer, J. E., & Katsikopoulos, K. V. (2016). There is more to creativity than generating ideas: The power of groups in developing ideas. *Creativity Research Journal*, 28, 247–257. doi:10.1080/10400419.2016.1195637

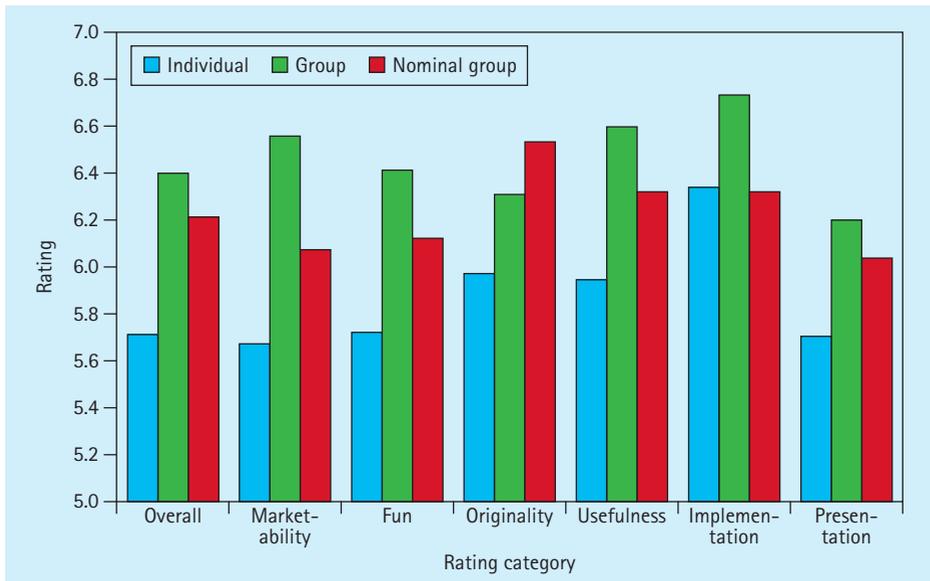


Figure 10. Average ratings of individuals, groups, and nominal groups in different evaluation categories for the language-learning games they developed. In the overall category, both types of groups received higher ratings than individuals; in the marketability category, groups received higher ratings than those of nominal groups, which were in turn higher than those of individuals; in the fun category, groups received higher ratings than individuals. All categories were rated on a scale of 1 (low) to 10 (high) (adapted from McMahon, Ruggeri, Kämmer, & Katsikopoulos, 2016).

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experimentally exploring the phase of developing an idea into a product. In the first study, they compared the performance of groups (i.e., participants working together), nominal groups (i.e., groups composed of individuals working separately, with their performances aggregated for analysis), and individuals in selecting and developing an original design for a language-learning game. They found that all three performed equally well. In the second study, one idea was preselected and given to the participants for further development. Creative processes were compared in terms of both quantitative measures of the final outcome and qualitative measures of the development phases. As Figure 10 shows, groups received higher overall ratings and higher ratings in the marketability category than both nominal groups and individuals, and higher ratings in the fun category than individuals. The qualitative data demonstrate that groups discussed a wider range of topics,

including the topic of marketability, than individuals.

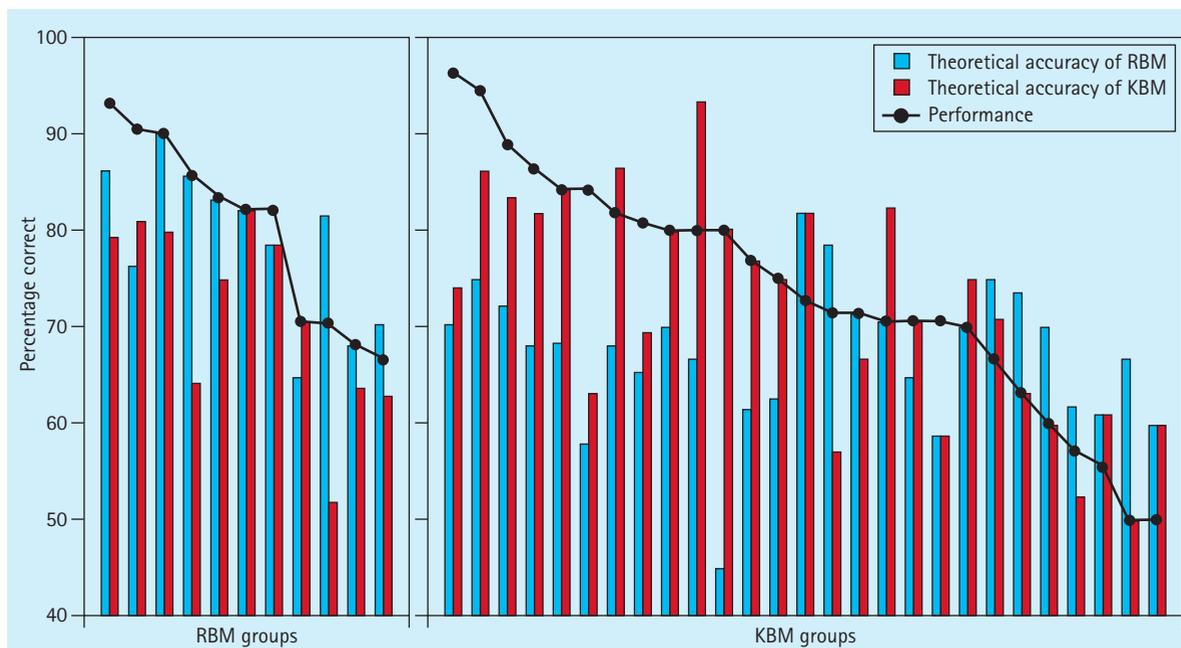
Altogether, the results from this research indicate that there may be benefits in developing ideas in a collaborative group rather than individually. Hence, it is not accurate to say that groups are inferior to individuals with respect to creativity.

#### Key Reference

**Kämmer, J. E., Gaissmaier, W., Reimer, T., & Schermuly, C. C.** (2014). The adaptive use of recognition in group decision making. *Cognitive Science*, 38, 911–942. doi:10.1111/cogs.12110

#### The Adaptivity of Group Decision Making

How do groups and individuals make decisions, and what factors influence their decision processes? Both the social psychology literature on group decision making and the cognitive psychology literature on individual decision making have addressed very similar questions, yet they remain largely unconnected. Kämmer, Gaissmaier, Reimer, and Schermuly (2014) combined the two literatures to investigate an important aspect of group decision making: Do groups select decision strategies adaptively? And if so, how?



**Figure 11.** Group performance in a paired comparison task in which groups judged which of two companies had a higher market capitalization. Two models were tested on their ability to describe group choices: (1) a recognition-based model (RBM), which assumes that group members who could use the recognition heuristic determined the group choice and (2) a knowledge-based model (KBM), which assumes that members who could use their knowledge determined the group choice. This figure shows the achieved and theoretical accuracy of the KBM and of the RBM in situations where both models were applicable. It can be seen that, for the RBM groups, the theoretical accuracy of RBM was higher and closer to the observed accuracy than that of the KBM (left panel) and vice versa for the KBM groups (right panel). These results suggest that groups behaved adaptively, adopting strategies that helped them achieve higher accuracy (adapted from Kämmer, Gaissmaier, Reimer, & Schermuly, 2014).

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The study focused on the recognition heuristic, which predicts that if only one of two alternatives is recognized and the other is not, the recognized one is inferred to have the higher value on the target criterion. Here, the task-relevant features were the validities of group members' recognition and knowledge that influenced the potential performance of group strategies. Forty-three groups consisting of three people each had to infer which of two German companies had a higher market capitalization. Results support the hypothesis that groups adaptively apply the strategy that leads to the highest theoretically achievable performance (see Figure 11). In other words, performance of a group is not necessarily improved by increasing the quantity of information exchanged; rather, the *adaptive* selection of group decision strategies determines the success of a group. Under some circumstances, this means that groups rely on the less knowledgeable members who happen to possess the more valid cue (i.e., recognition). The results of this study show that, in order to be successful, a group must select a strategy that fits to the structure of the task environ-

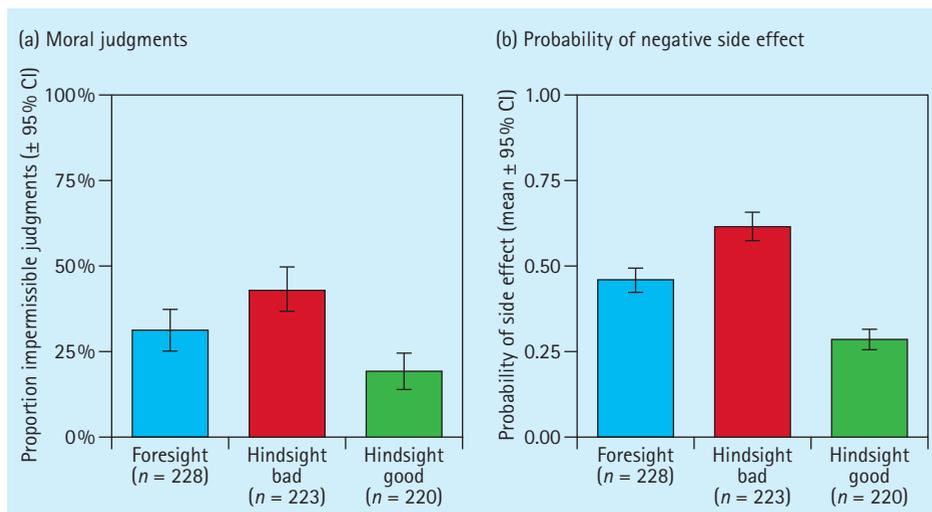
ment *and* the features and composition of its members.

### Moral Hindsight: Moral Judgments Under Certainty Versus Uncertainty

Uncertainty is a key feature of many situations in which moral judgments are made. Is it morally permissible to threaten a kidnapper with torture to find the victim, even if this risks the kidnapper's acquittal due to violation of procedural rules? Should a government cultivate genetically modified crops that could ensure food availability, even if it is uncertain whether these may cause severe allergies and the destruction of ecosystems and food chains? Although uncertainty is ubiquitous, most research on moral judgments has focused on problems in which all consequences are presented as certain (e.g., the famous "trolley dilemma"). By contrast, Fleischhut, Meder, and Gigerenzer (in press) investigated moral reasoning under uncertainty. Adopting a classic hindsight paradigm from the judgment and decision-making literature, they tested the predictions of two types of moral theories on how judgments should vary under un-

### Key Reference

Fleischhut, N., Meder, B., & Gigerenzer, G. (in press). Moral hindsight. *Experimental Psychology*.



**Figure 12.** Moral judgments and probability estimates for the negative side effects aggregated across six moral dilemmas. In the foresight condition, it was uncertain whether the side effect would occur; in the hindsight bad condition, it was known that the negative side did occur; and in the hindsight good condition, it was known that the side effect did not occur. (a) The way moral judgments vary across conditions reflects participants' inability to disregard outcomes, even though they remained uncertain when the decision had to be made: a moral hindsight effect. (b) A corresponding hindsight effect for probability estimates of the negative side effect. Importantly, the hindsight effect in probability estimates carried over to moral judgment solely for participants who indicated a cost-benefit trade-off as most important for their moral evaluation (adapted from Fleischhut, Meder, & Gigerenzer, in press).

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certainty and certainty across six real-world dilemmas. Specifically, in foresight, it was uncertain whether the cultivation of genetically modified crop would lead to severe allergies and destruction of eco systems, whereas in hindsight, it was known that these adverse side effects either occurred or did not. The key result was a hindsight effect in moral judgment (see Figure 12a). Participants in the foresight condition judged actions to be more morally permissible than participants in the *hindsight bad* condition, who knew that the negative side effects did occur. Conversely, foresight participants judged actions to be less permissible than participants in the *hindsight good* condition, who knew that negative side effects did not occur. The second finding was a classical hindsight effect when participants judged the likelihood of negative side effects: Although instructed to ignore the outcome of the decision, their probability judgments in hindsight mirrored their knowledge of the actual course of events (see Figure 12b). There was also a systematic relation between moral judgments and probability estimates: Participants who considered the action to be morally impermissible gave on average higher probability estimates for the negative side effect than participants who considered the action to be permissible. However, the hindsight effect on probability estimates corresponded to the hindsight effect on moral judgments solely for “consequentialist” participants who reported a cost-benefit trade-off as most important for their moral evaluation. Among participants who did not report a trade-off as the most important reason, a hindsight effect in probability judgments was observed, but did not carry over to the moral judgments.

This work highlights the importance of investigating moral reasoning under conditions that more closely resemble real-world dilemmas. It also provides new pathways for investigating how people make moral judgments in a fundamentally uncertain world.

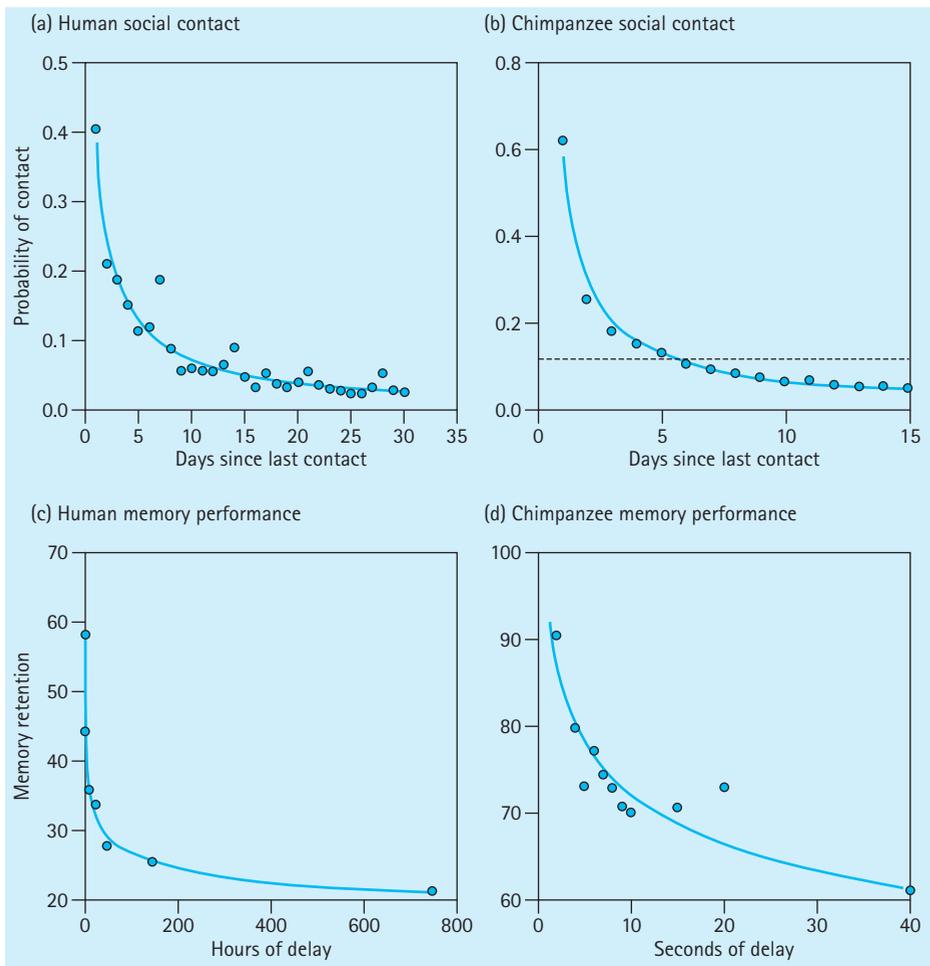
### **An Evolutionary Approach to the Influences of Social Contact on Cognition**

In 2016, more than 80 million Twitter users followed the President of the United States

Barack Obama and he, in turn, followed over 600,000 users. How did Obama remember all of these people? Of course, he did not have personal relationships with all of them, and likely had aides manage his account. But the scope of modern social networks raises interesting questions about how our cognition copes with the demands of our social world. To maintain relationships, it is critical to remember information about our social partners. In general, we are more likely to reencounter individuals whom we have encountered frequently and recently in the past. Our memory, therefore, might make a bet about needing information on social partners based on the pattern of past encounters: We should better remember more frequently and recently encountered partners. In fact, there are clear (power-law) patterns in how we encounter individuals in our social networks (see Figure 13a), and our memory shows the same pattern (see Figure 13c). However, the origin of this relationship is not clear. Does memory reflect patterns of social contact because memory has adapted over our lifetimes to how we encounter other individuals? Or is the connection between social contact patterns and memory important enough that it has been passed down evolutionarily? Stevens, Marewski, Schooler, and Gilby (2016) tested this question by investigating social contact patterns and memory in a phylogenetically closely related species—the chimpanzee (*Pan troglodytes*). They tested whether (1) chimpanzees show the same patterns of social contact as those observed in humans and (2) chimpanzee memory performance matches their social contact patterns. Analyzing 19 years of social contact data from the chimpanzees at Kibale National Park, Uganda, they found that chimpanzee social contact data in fact mirrored the human data, with a power-law relationship between past and future contact (see Figure 13b). Moreover, chimpanzee memory performance showed the same kind of pattern as in their social contact data (see Figure 13d). These findings suggest that human and chimpanzee memory have evolved to solve similar information-processing problems faced in their social networks. Discovering how human cognition

#### **Key Reference**

Stevens, J. R., Marewski, J. N., Schooler, L. J., & Gilby, I. C. (2016). Reflections of the social environment in chimpanzee memory: Applying rational analysis beyond humans. *Royal Society Open Science*, 3(8):16029314. doi:10.1098/rsos.160293



**Figure 13.** How does recency of encounter influence future social contact and memory performance in humans and chimpanzees? Previous work has shown that human memory performance reflects patterns of social contact. For example, both (a) the probability of future social contact and (c) memory performance decrease as a power function of the recency since encountering social partners and the objects to be remembered. Stevens, Marewski, Schooler, & Gilby (2016) searched for similar patterns in chimpanzees (*Pan troglodytes*) by measuring social contact patterns in wild chimpanzees and analyzing memory data from captive chimpanzees. They found that chimpanzees, like humans, also showed power-law relationships with recency for both (b) social contact and (d) memory performance, suggesting that human and chimpanzee memory have evolved to solve similar information-processing problems faced in their social networks (adapted from Stevens, Marewski, Schooler, & Gilby 2016).

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reflects and diverges from those of other species offers a promising route for better understanding how the social world shapes our cognition.

### Understanding the Process of How We Decide to Forgive

Cooperation among nonkin has received significant attention in the last decades. Although advances have been made in

understanding why performing costly actions for another's benefit can be adaptive, less is known about the computational processes used to make such decisions.

Tan, Luan, and Katsikopoulos (2016) studied forgiveness decisions, which are a key type of decision supporting recurrent cooperation. They argued that deciding whether to forgive someone can be viewed as a signal detection task: Forgiving is adaptive if a continued rela-

**Key Reference**

Tan, J. H., Luan, S., & Katsikopoulos, K. V. (2017). A signal-detection approach to modeling forgiveness decisions. *Evolution and Human Behavior*, 38, 27–38. doi:10.1016/j.evolhumbehav.2016.06.004

relationship with the person is fitness enhancing and not adaptive if the relationship is fitness reducing. As a consequence, the decision to forgive should be biased toward lowering the likelihood of the more costly error, which, depending on the context, may be either erroneously not forgiving or erroneously forgiving. Building on this conceptualization, the study examined two cognitive models that implement signal detection principles: fast-and-frugal trees (see Figure 14 for what they are and how they might be implemented in making forgiveness decisions) and Franklin's rule, a linear model. Tan et al. (2017) tested whether these models could describe forgiveness decisions in hypothetical scenarios and predict decisions in recalled real-life incidents. The study found that the models performed similarly and generally well—around 80%

accuracy in description and 70% in prediction. Moreover, this modeling approach enabled the decision bias of each participant to be estimated. The estimated biases were generally consistent with the prescriptions of signal detection theory and were directed at reducing the more costly error. In addition to testing cognitive models of forgiveness decisions, this study also contributes to forgiveness research by empirically demonstrating that people adopt reasonable decision biases in forgiving. Finally, although this study focused on forgiveness decisions, many other social decisions can also be understood from the perspective of signal detection theory and be investigated using the same methodology. This research is thus a demonstration of how cognitive models can be used to investigate the processes of social decisions.

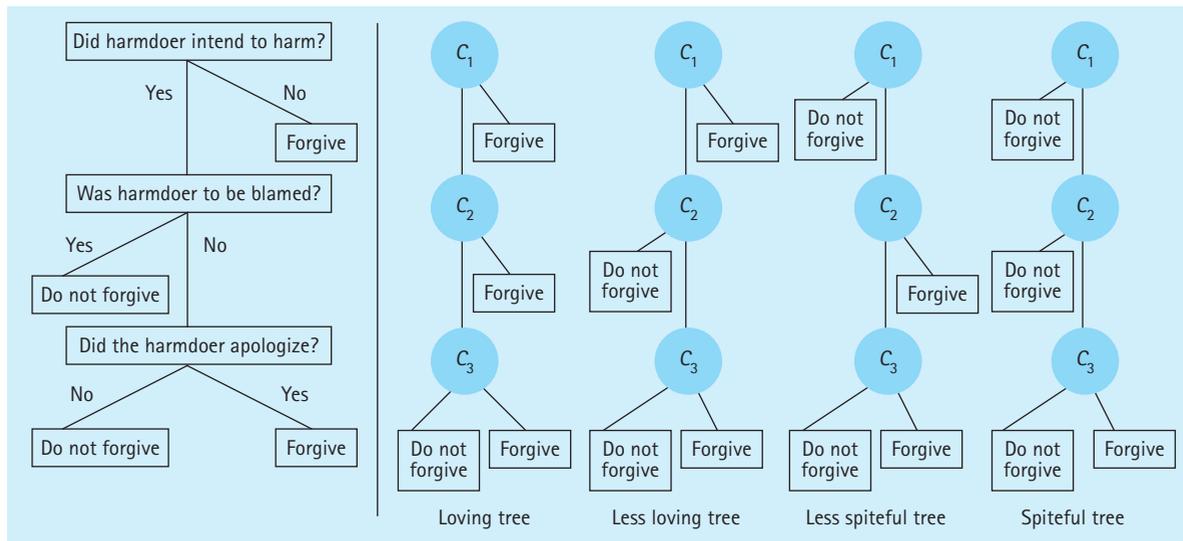


Figure 14. Fast-and-frugal trees in forgiveness decisions. In fast-and-frugal trees, cues are looked up sequentially and a decision can be made after each cue, without considering all subsequent cues. The left panel illustrates how an offended individual might make a forgiveness decision using a fast-and-frugal tree with three cues: intention, blame, and apology. The individual might first consider whether the harmdoer intended to harm. If there was no intent to harm, then the decision would be to forgive; otherwise, the next cue (blame) would be considered. Finally, the agent may consider whether the harmdoer apologized. The right panel shows the four exit structures of a fast-and-frugal tree, with  $C_1$ ,  $C_2$ , and  $C_3$  representing three cues in a fixed order. From left to right, the trees become more and more biased against forgiving; they are named according to their overall decision biases. The illustration on the left panel has the exit structure of a less loving tree (adapted from Tan, Luan, & Katsikopoulos, 2017).

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## Decision Making in the Wild

The study of bounded, ecological, and social rationality conceives behavior as the result of an interaction between cognition and environment. It investigates the conditions under which simple heuristics can both lead to faster, more accurate predictions and increase the transparency of the decision process. In this section, we present a selection of our work outside the laboratory: an analysis of how car dealers price used BMWs, a project with the Bank of England, a study on checkpoint decision making in the age of terrorism, and one on governmental paternalism ("nudging").

### Heuristic Pricing of Used Cars

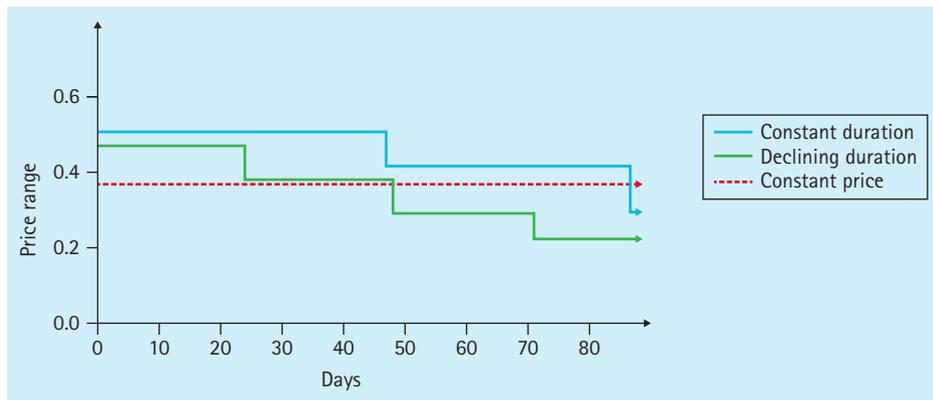
When economists build models of markets, they assume the ability to fully capture all relevant aspects of the decision situation, which would enable deducing the market equilibrium and the optimal strategy agents should employ. However, unlike rational choice models, firms compete in dynamic and complex environments and thus often have only limited information at their disposal. Under these conditions, how do firms set prices? Artinger and Gigerenzer (2016) tested whether firms employ an aspiration level heuristic for price setting as first proposed by Herbert A. Simon in 1955 for such situations.

Analyzing the pricing strategies of 745 used-car dealers on the basis of online market data and interviews, they found that virtually all dealers employ a form of aspiration level pricing, depicted in Figure 15. The heuristic

used by the dealers is to start off with a high initial price and sequentially lower it in fixed time intervals until the car sells. The heuristic explains the counterintuitive "cheap twin paradox," where two identical cars at the very same dealership are often priced thousands of euros apart. This occurs when the twin cars differ in terms of the time that they have been at the dealer, so that the price of the "older twin" has already been lowered more than the price of its "younger twin." In Figure 15, this corresponds to different points on the x-axis with one or more "steps" in-between. The heuristic also generates an aggregate pattern that is well described by a model of equilibrium price dispersion. However, unlike the equilibrium model, the aspiration level heuristic correctly predicts systematic pricing characteristics, such as high initial price, price stickiness, and the cheap twin paradox.

### Key Reference

**Artinger, F., & Gigerenzer, G.** (2016). Adaptive heuristic pricing. In J. Humphreys (Ed.), *Proceedings of the Seventy-Sixth Annual Meeting of the Academy of Management*. Advance online publication. Online ISSN: 2151-6561.



**Figure 15.** How do car dealers price used cars? Virtually all 745 dealers used one of three variants of the aspiration level heuristic: All dealers started at a fixed percentile of the price range. Then 51% of dealers used the "constant duration," strategy, where they kept the price constant for the same fixed interval across time for 24 days on average; 27% used "decreasing duration," where dealers sequentially lower the price, but decrease the duration for which consecutive prices are held constant from 48 days on average in the first step to 40 days in the second step; and 19% employed a "constant price," a special case of the aspiration level heuristic, where the initial price does not change (adapted from Artinger & Gigerenzer, 2016).

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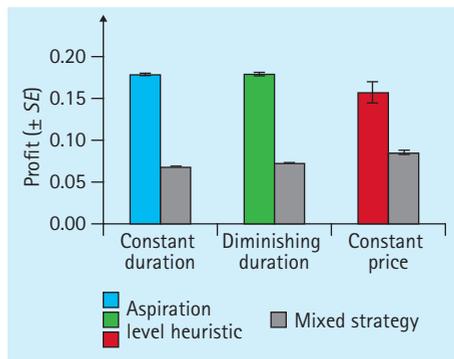


Figure 16. Simple adaptation heuristics can be more profitable than complex economic equilibrium pricing models (mixed strategy) (adapted from Artinger & Gigerenzer, 2016).

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Indeed about 14% of cars have a twin at the very same dealership. This analysis also provides first evidence that heuristic pricing can generate higher profits than the optimization strategy underlying the equilibrium model (see Figure 16).

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Aikman, D., Galesic, M., Gigerenzer, G., Kapadia, S., Katsikopoulos, K. V., Kothiyal, A., Murphy, E., & Neumann, T. (2014). *Taking uncertainty seriously: Simplicity versus complexity in financial regulation* (Bank of England Financial Stability Paper No. 28). London: Bank of England.

Gigerenzer, G., & Brighton, H. (2009). Homo heuristics: Why biased minds make better inferences. *Topics in Cognitive Science*, 1, 107–143. doi:10.1093/acprof:oso/9780199744282.003.0001

#### The Bank of England Project: Simple Heuristics for a Safer World of Finance

Since 2012, members of the Center have been meeting regularly with economists of the Bank of England to investigate alternatives to the present encumbrance of overly complex risk models and regulations. Both the private sector and public authorities have responded

to the growing complexity of the financial system with more complexity, whether through increasingly elaborate modeling and risk management or ever-lengthening regulatory rulebooks. But this helped neither to predict nor to prevent the most recent global financial crisis. In fact, financial models predicted that such a crisis was virtually impossible. For instance, in 2003, Robert Lucas, one of the most distinguished macroeconomists, declared that economic theory would protect us from future disaster: “Its central problem of depression-prevention has been solved, for all practical purposes, and has in fact been solved for many decades.” Five years later, the greatest crisis since the Great Depression hit. The project is led by Andrew G. Haldane, Bank of England’s Chief Economist and Executive Director of Monetary Analysis and Statistics, and Gerd Gigerenzer. Its goal is to combine the economic competencies of the bank with the research on simple heuristics from our group. The main question is whether heuristics can provide more robust and accurate tools for estimating key safety factors of the financial system, such as capital requirement and bank vulnerability. Heuristics can reduce estimation error and overfitting by virtue of estimating fewer parameters, as formally described in the bias–variance decomposition (Gigerenzer & Brighton, 2009). Figure 17 shows an example of a fast-and-frugal tree for assessing bank vulnerability. A

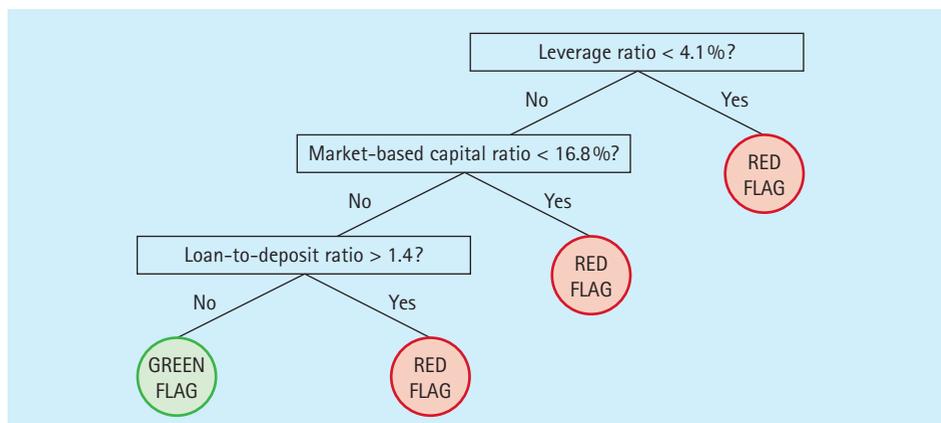


Figure 17. A fast-and-frugal tree for assessing bank vulnerability (Aikman et al., 2014). The tree was constructed using a combination of expert intuition (for selecting the three variables) and a statistical analysis for estimating the thresholds for each variable (adapted from Aikman et al., 2014).

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fast-and-frugal tree with  $n$  variables (or questions) has  $n + 1$  exits, one at each variable and two at the end, compared to  $2^n$  exits in a complete tree. The tree was constructed on the basis of data from before the global financial crisis and tested on data during the crisis. For an idea of how this tree works in practice, consider the case of UBS, which required significant financial support from the Swiss authorities during the crisis. Given its leverage ratio of 1.7 at the end of 2006, it is automatically red flagged on the first cue in the tree. This completely ignores the fact that the bank had a market-based capital ratio significantly exceeding 16.8% and a loan-to-deposit ratio well below 1.4 (the tree has a "noncompensatory" structure). By contrast, a regression model would balance UBS's low leverage ratio with its high market-based capital ratio and low loan-to-deposit ratio, and as a result might not give a strong warning signal. Figure 18 shows that the accuracy of the fast-and-frugal tree, as measured by the actual vulnerability during the crisis, compares favorably with standard logit models used in finance. These general results may have lessons for the design of regulatory standards. They high-

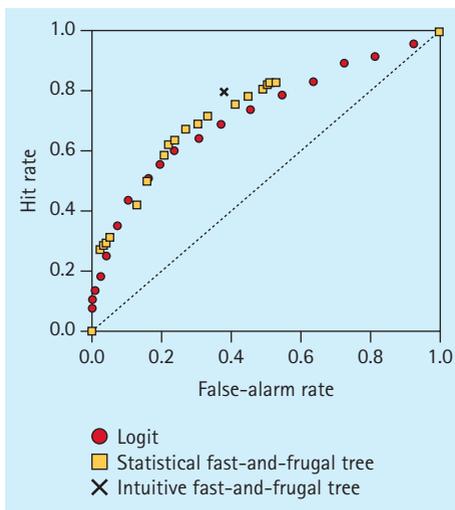


Figure 18. Less can be more in predicting bank vulnerability. The fast-and-frugal tree in Figure 17 performs as well as or better than standard logit models. Also shown are fast-and-frugal trees that are based purely on a statistical analysis of past data (without adding expert intuition to select the variables) (adapted from Aikman et al., 2014).

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light the importance of imposing a leverage ratio standard to complement risk-based capital requirements. And they suggest the usefulness of simple, high-level indicators to complement more complex metrics and other sources of information for assessing macroprudential risks. Moreover, simplicity in macroprudential policy may also facilitate transparency, communicability, and accountability, thus potentially leading to a greater understanding of the intent of policy actions, which could in turn help increase trust in such policies. Simple approaches are also likely to have wider benefits by being easier to understand and communicate to key stakeholders. For example, if senior management and investors have a better understanding of the risks that financial institutions face, internal governance and market discipline may both improve. Simple rules are not a panacea, especially in the face of regulatory arbitrage and an ever-changing financial system. But in a world characterized by Knightian uncertainty, tilting the balance away from ever-greater complexity and toward simplicity may lead to better outcomes for society.

### Unrealistic Assumptions About Perfect Information Flow May Underestimate Bank Vulnerability

Although financial theory typically assumes a perfect flow of information among financial agents, in reality, financial reporting is not real-time, reports are not always reliable (as in the case of Lehman Brothers), and some information is exclusively shared between business partners. The study by Davidovic, Galesic, Katsikopoulos, and Arinaminpathy (2014) adds realism to a model of interbank markets by introducing uncertainty into what banks know about other banks. In their model, information spreads through the lending network established among banks, and the quality of information depends on the proximity of the information source in the network—information is more accurate and up-to-date between direct partners than between banks connected via other banks. Instead of having complete information, the latter receive information that is delayed, noisy, or local. For instance, in one of their

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Davidovic, S., Galesic, M., Katsikopoulos, K. V., & Arinaminpathy, N. (2014). Modeling uncertainty in banking networks. In S. Omatu, H. Bersini, J. M. Corchado, S. Rodriguez, P. Pawlewski, & G. Buccarelli (Eds.), *Distributed computing and intelligence: 11th International Conference (Advances in Intelligent Systems and Computing No. 290)* (pp. 107–114). Berlin: Springer. doi:10.1007/978-3-319-07593-8\_14

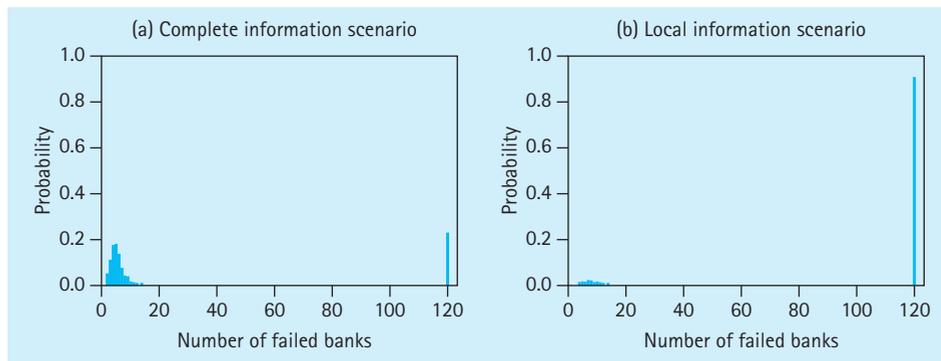


Figure 19. Probability distributions of the number of failed banks after a strong, externally applied financial shock to a banking system with 120 banks when (a) banks have perfect information about the lending network and (b) banks have reliable access to information from their direct neighbors only. When the information flow is uncertain as opposed to perfect, the probability that all 120 banks fail increases significantly (adapted from Davidovic, Galesic, Katsikopoulos, & Arinaminpathy, 2014).

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uncertainty scenarios, the authors introduce the concept of “locally perceived” confidence, where banks exclusively rely on information from the neighboring banks. As a result, the local impact of a financial shock is more intense, but initially limited to the neighborhood of banks directly affected. This local impact, however, is subsequently transmitted through the system (analogous to the dynamics of crack propagation in a solid medium), resulting overall in a significantly higher risk of system collapse than if complete information is assumed (see Figure 19).

academics working in fields that overlap with economics.

Classic decision theory is based on rules of consistency (such as transitivity or Bayes’ rule), and its implicit assumption is that consistency leads to more accuracy or to better health or wealth. The authors could not find any evidence linking belief inconsistency to belief inaccuracy or economic loss (see

### Key Reference

Berg, N., Biele, G., & Gigerenzer, G. (2016). Consistent Bayesians are no more accurate than non-Bayesians: Economists surveyed about PSA. *Review of Behavioral Economics*, 3, 189–219. doi:10.1561/105.00000034

### The White-Coat Heuristic, Consistency, and Prostate Cancer Screening

Berg, Biele, and Gigerenzer (2016) studied decision making about whether or not to participate in prostate cancer screening using Prostate Specific Antigen (PSA) tests. They asked two questions. First, does consistency correlate with accuracy in judgments? Second, do economists follow their own logic of rational choice by weighting the pros and cons and, if not, what is the process of their decision making?

The authors conducted face-to-face interviews with attendees of the annual meeting of the American Economic Association (attended by more than 10,000 registered conference participants). Of 133 respondents, 123 (92%) identified themselves as economists; the others were political scientists and



Figure 20. Inconsistency is not positively correlated with inaccuracy ( $r = -0.04$ ). Inconsistency is measured by Bayesian consistency between estimated sensitivity, specificity, and other “elicited frequencies”; accuracy was measured by the discrepancy between estimated values and published estimates. For instance, the two persons with the most inaccurate beliefs (highest values on the y-axis) were perfect Bayesians, whereas the two most inconsistent persons (highest values on the x-axis) had below-average inaccuracy (adapted from Berg, Biele, & Gigerenzer, 2016).

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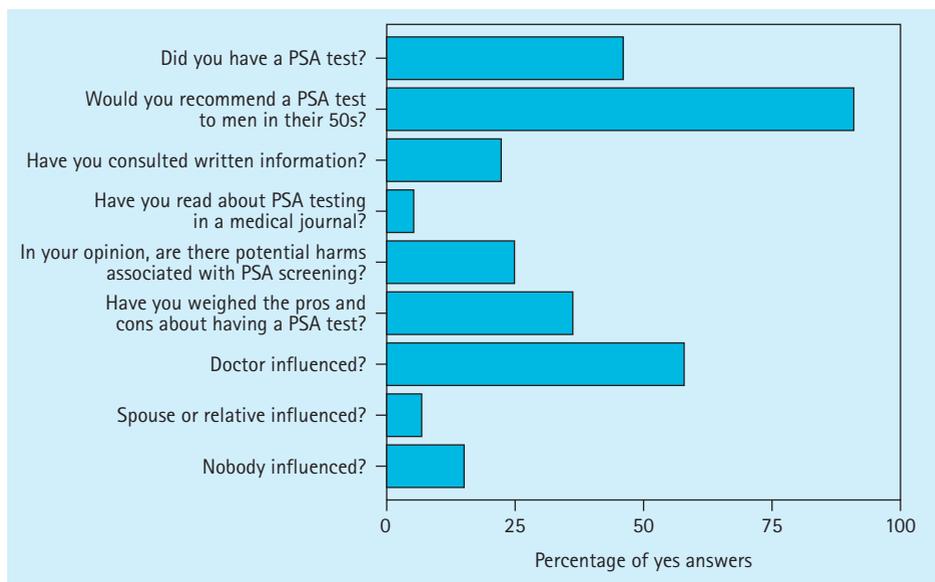


Figure 21. A survey of economists' knowledge and decision making with regard to prostate cancer screening (PSA tests). For instance, only 36% said that they had weighed the pros and cons of screening before deciding whether to take the PSA test. In contrast, 65% said that their doctor (58%) or their spouse (7%) had influenced their decision (adapted from Berg, Biele, & Gigerenzer, 2016).

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Figure 20). The correlation between consistency and accuracy was basically zero, even slightly negative. Economists with consistent (i.e., Bayesian) conditional beliefs about the sensitivity and positive predictive value of the PSA test had unconditional beliefs about the risk of prostate cancer that are, if anything, less accurate than the beliefs of inconsistent non-Bayesians. This lack of correlation between consistency and accuracy mirrors the lack of evidence that violations of coherence are costly in terms of health, wealth, or happiness (Arkes, Gigerenzer, & Hertwig, 2016).

How do economists make decisions about PSA screening? Keeping in mind the usual caveats about interpreting self-reports on issues as personal as medical decision making, Berg et al. (2016) asked respondents whether they had acquired written information on the PSA test, the sources of that information, and whether or not they had weighed the pros and cons when deciding whether to be tested. More than half said that they had not weighed pros and cons (see Figure 21). Yet about two thirds said they had followed

doctors' recommendations—a heuristic sometimes referred to as the white-coat heuristic—or their spouses' advice. The influential role of social heuristics is well-documented (e.g., having the PSA test because a spouse or doctor or another familiar person recommended it), yet it is nevertheless surprising in the context of PSA testing, given that medical organizations such as the U.S. Preventive Services Task Force (USPSTF) recommend against routine PSA testing. Because there is proof of severe harms (such as incontinence and impotence from surgery), but no proof that lives are saved, medical organizations tell every man to weigh the benefits carefully. Yet the present study indicates that PSA decisions depend more on social heuristics than on weighing the pros and cons; that is, they rely mostly on the white-coat heuristic.

### Saving Civilian Life in the Age of Terrorism

Reducing civilian casualties in stability operations, such as the NATO mission to Afghanistan (ISAF), is not only a moral but also a political and strategic imperative. Several strategic directives aimed at minimiz-

### Key Reference

Arkes, H. R., Gigerenzer, G., & Hertwig, R. (2016). How bad is incoherence? *Decision*, 3, 20–39. doi:10.1037/dec0000043

## Key Reference

Keller, N., & Katsikopoulos, K. V. (2016). On the role of psychological heuristics in operational research; and a demonstration in military stability operations. *European Journal of Operations Research*, 249, 1063–1073. doi:10.1016/j.ejor.2015.07.023

ing civilian casualties have been issued by ISAF commanders, such as Petraeus in 2009. These, however, have failed to reduce civilian casualties in “force protection” situations—situations in which a military presence out in the field feels itself under threat and engages in signaling or self-defensive measures. The greatest threat for these troops is that of a vehicle-borne suicide attack: cars laden with explosives driven to a checkpoint or patrol and detonated.

On the basis of a goal-directed task analysis (analysis of classified documents, pre-deployment training observations, and expert interviews), Keller and Katsikopoulos (2016) constructed a fast-and-frugal tree (FFT) to assist soldiers in differentiating suicide attacker vehicles from civilian vehicles (see Figure 22). This FFT contains three binary cues:

- whether the vehicle contains one or more than one occupants;
- whether the approaching vehicle complies with military signals (slows down or stops) or not;
- whether any additional threat cues are present or not.

After construction of the FFT, a database of 1,060 ISAF reports of force protection incidents (January 2004 – December 2009) became available. These reports include 7 suicide attacks and 204 civilians erroneously injured or killed by ISAF forces. Because the FFT was not fitted to these reports, we can estimate its performance if it had been used instead.

Testing the FFT on the ISAF reports revealed that using it would have reduced civilian casualties by over 60%: from 204 to 78 civilians killed or injured. The FFT would also have enabled fast decisions: Across all 1,053 incidents where no suicide attacker was present, the FFT would have used on average only 1.2 cues, and 84% of the cases would have been categorized after looking up the first cue only. Finally, the FFT may improve soldier safety; while all 7 recorded suicide attacks were successful, the FFT could have identified all those attackers displaying noncompliant behavior.

The FFT, together with guidelines on action selection, was published in a classified

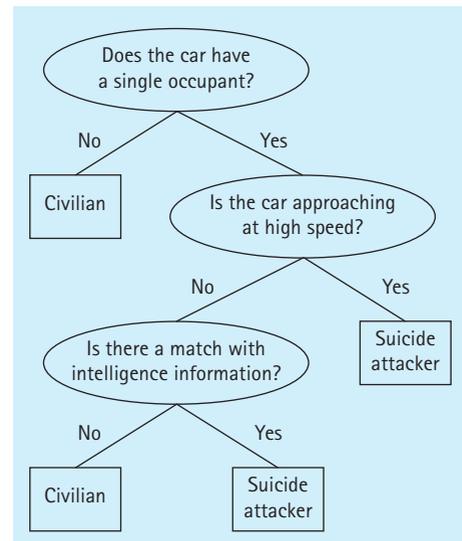


Figure 22. A fast-and-frugal tree to reduce civilian casualties in stability operations, such as checkpoints or patrols. The tree asks (at most) three questions, and a test on 1,060 critical incidents in ISAF reports shows that using it would have reduced the number of civilians killed or injured from 204 to 78 (adapted from Keller & Katsikopoulos, 2016).

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German Federal Armed Forces information leaflet and distributed to all troops (Aus dem Einsatz lernen, 02–2013). It also featured in *Science News* (10 August 2015) and a *ZEIT* Interview (17 September 2014).

## Governmental Paternalism: On the Supposed Evidence for the Need to “Nudge” the People

Can the general public learn to deal with risk and uncertainty, or do authorities need to steer people’s choices in the right direction? In their book *Nudge*, Richard Thaler and Cass Sunstein (2008) argue that psychological research has shown people’s reasoning to be systematically flawed, more in line with Homer Simpson than *Homo economicus*. In addition, they find little evidence that people can be de-biased from their cognitive illusions, which they liken to stable visual illusions and the “reptilian brain,” known as “System 1.” Pessimistically, the authors conclude that governments need to step in and steer their citizens in the right direction. This philosophy of nudging is called “libertarian

## Key Reference

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

paternalism," and governments in the United States, the United Kingdom, and elsewhere have been quick to assemble nudging teams to influence the public for their benefit. Nudges are nothing new, being the bread-and-butter of marketing and persuasion. But what is new is justifying them on the basis of people's irrationality. Libertarian paternalism's justification for governmental intervention deviates greatly from that of neoclassical economic theory, where intervention may be deemed necessary to correct imperfections of the market, such as when a firm has a monopoly. If, however, the imperfections are engraved in our brains rather than in the market, as libertarian paternalists assume, there is little hope of redressing them. In this very sense, libertarian paternalism is more "red-blooded" than some forms of hard paternalism, even if it does not endorse coercion (Rebonato, 2012).

Gigerenzer (2015c) analyzes the scientific evidence underlying the justification of libertarian paternalism through psychological research, focusing on three so-called systematic deviations from rationality presented by Thaler and Sunstein: framing effects, violations of Bayesian inference, and heuristics.

- (1) People "make different choices depending on the wording of the problem," which is known as the *framing effect*.
- (2) People "fail to make forecasts that are consistent with Bayes' rule."
- (3) People "use heuristics that lead them to make systematic blunders," which is part of the postulate that using statistics and logic always leads to more accurate judgments than when relying on heuristics and intuition.

(1) *Framing*. A framing effect occurs when people's choices differ depending on how two "logically equivalent" statements are framed. This behavior is said to be inconsistent with rational behavior because it violates the principle of "description invariance." As Thaler and Sunstein put it, the fact that people are influenced by framing demonstrates that humans are "mindless, passive decision makers" (2008, p. 40).

Libertarian paternalists, including some behavioral economists, may be among the

last professionals who cherish the ideal that logic *alone* provides a universal yardstick for intelligent choice. By contrast, psychological research by Craig McKenzie, Anton Kühberger, and others has shown that logically equivalent frames are not necessarily informationally equivalent. People (such as health-care providers) use framing to signal recommended options and listeners (such as patients) tend to understand the message between the lines. All in all, the principle of descriptive invariance is, by itself, an inappropriate general yardstick of rationality. Framing effects, defined as the violation of this principle, can be the result of strategic interaction, signaling of recommended options, and other forms of social intelligence. These frequently intuitive forms of intelligence have been misinterpreted in the behavioral economic literature as cognitive errors that are hard to unlearn. What this literature overlooks is that when intuition is more ecologically rational than logic, there is little need for governments to educate people out of their "logical errors."

(2) *Bayesian Inference*. Psychological research on Bayes' rule is conducted within two separate research programs. The first is the Bayesian rationality program, spearheaded by researchers, such as Ward Edwards, Nick Chater, and Josh Tenenbaum, who all conclude that cognitive functions, such as memory or perception, can typically be described as Bayesian inference. Note that behavioral economists routinely claim that these fast, unconscious, and automatic judgments (the so-called "System 1") do not work according to the rules of probability. According to the cognitive scientists just mentioned, however, they do.

The second paradigm does not involve probability learning, but instead considers textbook problems in which the probabilities are already numerically stated. These tasks are called *decisions from description* as opposed to *decisions from experience* (Hertwig & Erev 2009). In contrast to the early work by Kahneman and Tversky, which concluded that people systematically violate Bayesian rationality, research beginning with Gigerenzer and Hoffrage (1995) has shown that using *natural frequencies* instead of *conditional*

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Gigerenzer, G. (2014c). *Risk savvy: How to make good decisions*. New York: Viking.

*probabilities* facilitates Bayesian reasoning. This technique has since been tested in a large number of contexts and successfully applied in the fields of law and medicine. Moreover, it was shown that even fourth-graders can make consistently Bayesian inferences when probabilities are formulated as natural frequencies (Gigerenzer, 2014c).

(3) *Heuristics*. Since the 1990s, our research has shown that, in situations of uncertainty (as opposed to fully known risks), heuristics can often outperform more complex strategies. One formal way to understand why and when this occurs is the bias-variance dilemma (Gigerenzer & Brighton, 2009). Thus, relying on heuristics is second-best only in situations where the risks are known for certain, not under uncertainty.

The article also discusses libertarian paternalists' problematic ideal of benevolent choice architects who want only the best for the people, while also knowing exactly what the public wants. Flaws in this idealistic assumption have been highlighted for one by the 2011 Report of the House of Lords on nudging, which suggested that the Cameron Government, who implemented a nudge team, used nudging in part to avoid cracking down on regulating industry. Rather than banning advertisement of unhealthy food targeted at children and risking conflict with the food industry, for instance, governments may welcome soft strategies, such as a program that places apples rather than chocolate within eyesight of children in school cafeterias. The article concludes that evidence is lacking for the claim that we are hardly educable and that nudging is not the solution. Even a well-intending government will not stay in power forever; when a less benevolent person

takes over, they may well nudge people in a different direction. A more enduring solution would be to invest in public risk literacy. To be effective, education should start early, before young people are seduced into smoking, eating unhealthy food, and similar behaviors. A modern technological democracy needs less paternalism and more critical citizens.

## The Monthly "Unstatistik"

Together with economist Thomas Bauer and statistician Walter Krämer, Gerd Gigerenzer writes a monthly column called the "Unstatistik des Monats," that is, the misleading statistic of the month. Selecting a media report that cites misleading statistics, the authors explain what has been claimed, why it is wrong, and what is the general principle that the reader needs to become aware of—such as, that a correlation is not a causation or that *relative* risk increases are often used to frighten people while *absolute* risk increases are more transparent. Topics range from reports about studies on genetically modified food to claims that Microsoft's search machine can detect pancreas cancer and increase survival to what Berlin's former mayor Klaus Wowereit meant when stating that the new Berlin airport is "98%" finished. The Unstatistik is a nonprofit service to the public and available at [www.unstatistik.de](http://www.unstatistik.de). It is copublished by the magazine Capital and reported each month by dozens of newspapers and other media. A collection of the columns appeared in Bauer, Gigerenzer, and Krämer (2014), and the German Bundeszentrale für politische Bildung (Federal Agency for Civic Education) has reissued the book in their own series. A Korean translation is in press.

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(last update: Spring 2017)

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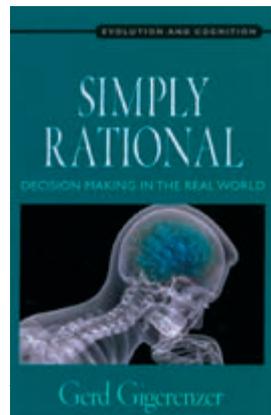
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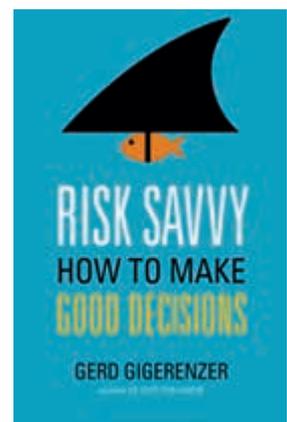
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**Center for  
Adaptive Rationality**

Director: *Ralph Hertwig*



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"Human beings viewed as behaving systems are quite simple. The apparent complexity of our behavior over time is largely a reflection of the complexity of the environment in which we find ourselves."  
*Herbert A. Simon, 1996*

## Introductory Overview

Inspired by Herbert Simon's notion of bounded rationality, the Center for Adaptive Rationality (ARC) seeks to understand how flesh-and-blood decision makers of all ages cope with the staggering uncertainty of the modern world. Uncertainty is everywhere. From the profound to the mundane, it cuts through almost every domain of life and is nigh on impossible to escape: How much of our limited resources should we devote to insuring ourselves against the risks of modern life? Would hiring this person make our team stronger? And which of my choices as a parent promise to enhance my children's well-being? How people reckon with uncertainty is one of the most vexing problems in the study of human choice and decision making.

We have investigated how real people—boundedly rational actors, as Herbert A. Simon portrayed them, rather than trained decision analysts—manage to operate in an uncertain world. We argue that the evolved and continuously learning cognitive system of the human mind has developed powerful tools to grapple with uncertainty. Like any good mechanic, the *adaptive cognitive system* of the mind has more than one tool to deal with the many forms of uncertainty and ensuing problems it encounters. Thus, we have challenged the common conjecture that people manage uncertainty in a domain-general way by reducing it to a probability (subjective or actuarial), much like a processor of big data might do. Specifically, we have examined three major classes of cognitive tools: *ecologically rational heuristics*, *exploration strategies*, and *collective intelligence strategies*. These tools help people tame the world's uncertainty and act on the basis of the imperfect, noisy, and incomplete information available. Yet uncertainty also lurks within the adaptive toolbox itself. Like any tool, cognitive tools are fallible and work well in some situations, but not in others. These limitations raise new questions: Which heuristic to choose in a specific context? How much to explore before making a decision? When is it wise to rely on the wisdom of crowds? Selecting a cognitive tool is thus in itself a decision under uncertainty. Our goal has been to examine this crucial dimension of the cog-

nitive system's internal uncertainty and how it interacts with people's ability to grapple with uncertainty in the world. Furthermore, we examined how the use of these cognitive tools develops over the lifespan and responds to the challenges of cognitive aging. The psychologists, economists, biologists, engineers, neuroscientists, and philosophers in our research group address these questions using a variety of methods, including behavioral experiments, computer simulations, mathematical analyses, and neuroscientific tools. Informed by our insights into how people make decisions, we propose ways to boost citizens', patients', doctors', and policy-makers' competence to make better decisions. In the following, we outline the theoretical tenets and major research areas and highlight the work being carried out therein between 2014 and 2016.

### The Heuristic Mind

*Heuristics* are computationally inexpensive and informationally frugal cognitive strategies, each one representing a bet on the structure of the environment at hand. This "gamble" pays off to the extent that the heuristic selected by the decision maker fits the statistical structure of the given environment. What are the statistical structures present in the real world? How do they arise? And how can they be exploited by heuristics? We have analyzed these questions by analyzing paradigmatic environmental structures

such as the risk–reward structure (i.e., the magnitude of the world’s rewards is inversely related to the likelihood of those rewards occurring). Furthermore, we have analyzed what factors determine which cognitive strategy is being selected and focus on one powerful, but often-neglected, selecting force, namely, emotions. Finally, we have invested much effort in integrating the framework of simple heuristics with various other important modeling frameworks in the cognitive and the behavioral sciences and have demonstrated that this theory integration is not a one-way street but can benefit both frameworks in question.

### **The Exploring Mind**

When Robinson Crusoe was stranded on his desert island, he knew nothing about it. Before taking vital actions—building a shelter, hunting, and preparing food—he made use of perhaps the quintessential tool to reduce uncertainty: He explored the island’s terra incognita. In our own lives, we constantly find ourselves in situations, domains, and circumstances that are unfamiliar to us and that leave us no choice but to actively explore them. How do people explore? How much do they explore? Do they adapt their search to the demands of the environment, the presence of others, and the demands of their mind? And how does the Robinson Crusoe in us decide to move from exploration to action? We have conducted extensive investigations into how people search externally for information and make decisions based on this information—now known as research on *decisions from experience*—as well as how people search internally for information and how postdecisional search can be both adaptive and inform the mind’s confidence. We have also advanced research on a largely neglected phenomenon in discussions on human rationality, deliberate ignorance. Sometimes, the best way to deal with the uncertainties and cruelties of life is, paradoxically, to prefer willful ignorance to knowledge.

### **The Collective Mind**

With the arrival of Man Friday, Robinson Crusoe’s life changed considerably. The presence

of others is often a source of uncertainty. How will they respond to our actions? Will they compete or cooperate? Can we trust them or not? At the same time, teaming up with others is an enormously powerful tool to reduce uncertainty. Pooling our distributed, incomplete, and uncertain knowledge boosts our power to make accurate predictions. By such pooling, we insure ourselves against the chance of a single individual going astray in the terra incognita. But sometimes taking exactly that risk is better than teaming up with others. We have investigated both the challenges and the benefits of socially shared environments and decision making. Specifically, we examined how people navigate physically crowded spaces with simple heuristics; how collective dynamics shape people’s notions of what threatens them; and under what conditions it pays to join forces with others and when it is better to remain a solitary decision maker to achieve vital tasks such as medical diagnostics. We conclude that—as in the case of an individual’s adaptive selection of cognitive strategies—the potential of collective intelligence needs to be harnessed in an ecologically adaptive way, rather than relying on it blindly.

### **The Unfinished Mind**

The mental tools available to us for dealing with uncertainty are not set in stone. They are subject to developmental changes and rooted in a cognitive architecture that likewise changes constantly. The heuristic mind, for instance, hinges on the flexible and adaptive selection of heuristics. The exploring mind hinges on working memory. These capacities are subject to developmental transitions and cognitive aging, thus creating another source of uncertainty. We have made much progress in better understanding the characteristic trajectory of risk preferences across the lifespan; how cognitive aging limits the ability to explore the world and how it affects the ability to use heuristics adaptively. Furthermore, we explored when and how children begin to use ecologically smart heuristics and what is behind the conundrum of risk-taking adolescents.

### **The Boosted Mind**

According to Thomas Jefferson, democracy depends on an informed and educated electorate. The currently most influential approach to informing public policy based on behavioral insights, however, has largely abandoned the goal of making citizens competent. Often called “nudging,” this approach assumes that people suffer from difficult-to-correct “decisional irrationalities” that lead them to make choices detrimental to their health, wealth, and happiness. Its proposal for containing the fallout from these irrationalities is to let policymakers, for instance, nudge people toward better outcomes by changing the default option in the decision environment. Yet although people clearly do not always make good decisions, decision making is not as egregiously irrational as suggested

by the nudge approach. We therefore believe that there is a compelling alternative to nudging. By shedding light on the mind's repertoire of cognitive strategies and their interactions with the world, we can empower people to make choices that are good for them through changes in the environment, an enriched cognitive and motivational repertoire, or both. Doing so enables people to build their own competencies—and to make up their own minds—by boosting their decision-making competences. Therefore, we have contributed to the development and the test of various boosts for doctors, patients, parents, and citizens. In our view, Thomas Jefferson's belief in the importance of an educated and informed public is as relevant today as it was in his time.

## Research Area 1: The Heuristic Mind

In spite of the inescapable bounds of the mere mortal's decision making, good—and sometimes even approximately optimal—performance can be achieved under informational and computational constraints. The Center's study of *bounded rationality* between 2014 and 2016 has aimed to make progress with regard to three important issues: (1) strategy selection and the impact of emotions; (2) environmental structures and how they can be exploited to reduce uncertainty; (3) theory integration and how models of heuristics and other frameworks of cognitive and economic processes can be related to each other.

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### The Role of Emotions in Boundedly Rational Decisions

Are emotions epiphenomenal bystanders of the actual forces behind decisions or do they also actively shape decisions, with potentially detrimental or beneficial effects? For much of the 20th century, scholars from Freud to Skinner clashed over the power of emotions or the alleged lack thereof to steer and explain behavior. In contrast, in decision science throughout most of its history, descriptive and normative investigations of human decision making often had surprisingly little to say about how emotions influence—or should influence—the computations behind decisions, and what potential role they might play for people's use of heuristics. Notwithstanding the important seminal work of Simon, Mellers or Slovic on the role of emotions and "emotion-based choice," this relative neglect has only recently been supplanted by an unprecedented surge of interest. An "emotions revolution" has taken place, particularly in the neuroscientific study of decision making, putting emotional processes on an equal footing with cognitive ones. Yet, as we (Volz & Hertwig, 2016) argued, the concepts and processes discussed in affective neuroscience often remain vague, and conclusions about the implications of emotions for rationality are contradictory and muddled.

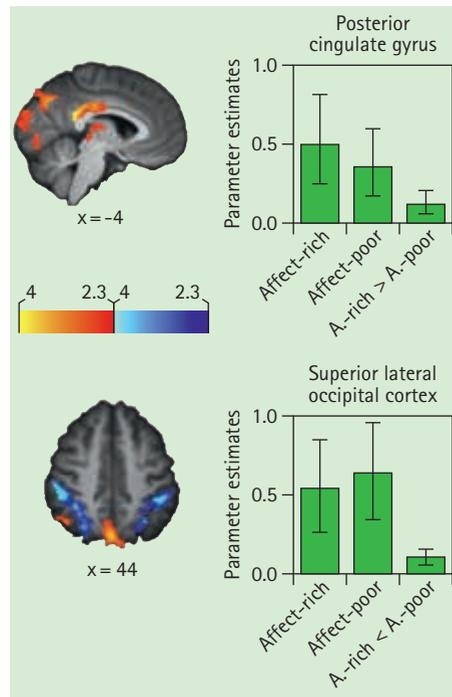
We (Volz & Hertwig, 2016) recently examined proposals of how the interaction of cognition and emotions can be modeled. Unfortunately, there is no clear blueprint for building such models. Yet, as we argued, one possible and fruitful approach is to start with an established model of decision processes and to consider which processes can be altered by emotions. Take, for illustration, risky choice, where a decision maker must choose between two or

more gambles, with each offering a set of possible outcomes and associated probabilities. There are at least two approaches to modeling how, for instance, affect evoked by the imagery of possible outcomes impacts the computational processes giving rise to risky choice. Some researchers have taken cumulative prospect theory (CPT) as a starting point and postulated that affect alters the default pattern of probability weighting—from weak to strong nonlinear weighting. The difference attributed to affect, an "affect gap" in risky choice, is thus one of degree, not of kind. Another approach, employing models of heuristics as a cognitive choice framework, postulates that people are adaptive users of simple heuristics and select different cognitive strategies depending on several factors, including the amount of affect triggered by a task. Specifically, affect is assumed to *qualitatively* alter the mode of processing probability and outcome information—from the selection of processes that integrate all available information to the selection of a heuristics choice process in which probabilities, in the most extreme case, are completely ignored.

The predictions of these two frameworks of how emotions and cognition interact to produce risky choices can be studied behaviorally and through cognitive modeling and brain imaging. We (Suter, Pachur, & Hertwig, 2016) followed the first route and fitted CPT to the choices of individual participants, separately for choices between options with affect-rich outcomes (adverse medical side effects) and affect-poor outcomes (monetary losses). Additionally, we tested a simple strategy implementing probability neglect, the minimax heuristic. It chooses the option with the highest minimum payoff, irrespective of the probabilities involved. The results indicated that only a

few participants relied on minimax in affect-poor choices (i.e., most people were classified as relying on CPT). However, a substantial portion used minimax for affect-rich choices. We (Pachur, Hertwig, & Wolkewitz, 2014) further corroborated this difference in strategy use by measuring people's information search before making an affect-rich or affect-poor choice. Consistent with the use of a simple, probability-blind heuristic, people conducted more within-attribute comparisons and paid less attention to probability information in affect-rich relative to affect-poor choices.

Considering the question of whether people's choices reflect genuine neglect of probabilities or amplified probability distortion as a result of affect, we (Suter, Pachur, Hertwig, Endestad, & Biele, 2015) compared brain activation during decision making in affect-rich versus affect-poor domains. According to the probability-weighting account, which assumes a multiplicative combination of values and probabilities, activations during affect-poor and affect-rich choices should equally strongly indicate the recruitment of executive function and calculative processes. According to the heuristics account (minimax), in contrast, calculative processes are expected to be less triggered in the affect-rich domain. Furthermore, affect-rich choices should reflect the representation of the outcomes' emotional value. The activations we observed in a functional magnetic resonance imaging (fMRI) study were consistent with these predictions. Figure 1 shows that voxels in the posterior cingulate gyrus and thalamus, indicating recruitment of autobiographical memory, were more active in affect-rich than in affect-poor choices. By contrast, voxels in the supramarginal gyrus and the superior lateral occipital cortex, indicating recruitment of executive functions and calculative processing, were clearly more active during affect-poor choices. Taken together, behavioral, computational modeling, and neuroscientific results converge and suggest that in the domain of risky choice, affect is involved in the process of strategy selection. Affect appears to trigger choice strategies that discount probability information and shift attention primarily to the severity and magnitude of outcomes.



**Figure 1.** Greater activation for affect-rich choices than for affect-poor choices in the posterior cingulate gyrus and the thalamus; greater bilateral activation for affect-poor choices than for affect-rich choices in the supramarginal gyrus and the superior lateral occipital cortex. The bar plots show the proportion of signal change for contrasts versus baseline and for high-level contrasts (separately for the affect-rich and affect-poor conditions as well as for the difference between them), with error bars indicating 90% confidence intervals (adapted from Suter, Pachur, Hertwig, Endestad, & Biele, 2015).

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### Heuristics and the Structure of the Environment

Besides emotions, another key factor enabling and shaping heuristic decision making is the environment's structure. The environments people encounter—from their social networks (Pachur, Schooler, & Stevens, 2014) to their everyday risky decisions (Pleskac & Hertwig, 2014)—often feature systematic regularities that a heuristic can exploit to thus make adaptive decisions. For instance, we (Pleskac & Hertwig, 2014) carried out an ecological analysis of a set of real-life gambles, including the domains of roulette, lottery tickets, researchers' gamble on where to publish, and farmers' gambles on the artificial insemination

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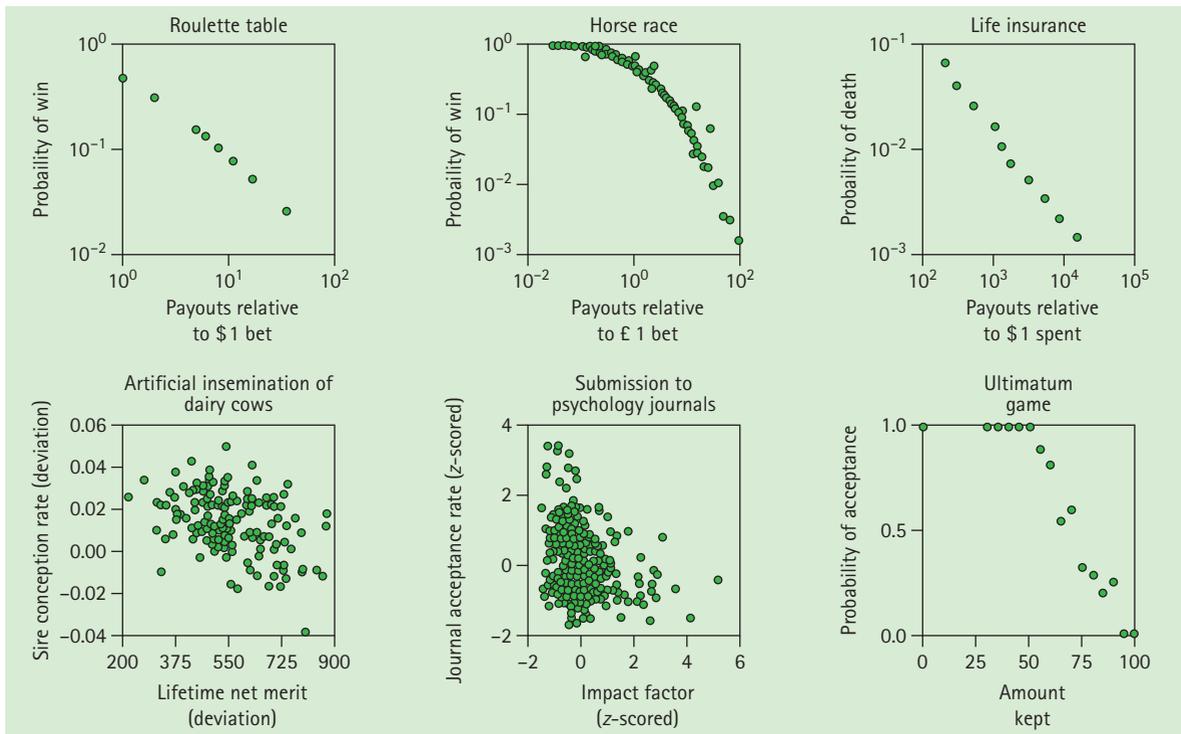


Figure 2. Relationship between payoffs and probabilities in six domains of real-life gambles. All the payoffs have been transformed to be relative to \$1 or £1 spent (adapted from Pleskac & Hertwig, 2014).

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nation of dairy cows. We found a specific regularity here. As shown in Figure 2, the big rewards people seek to gain (e.g., in roulette or in insurance) are relatively unlikely to occur. Across all domains, there was an inverse relationship between the probability of a reward and its magnitude. In fact, for roulette, horse races, and life insurance, the relationship took a precise form: The probabilities followed a power function of the payoffs. We showed that this power-law relationship between probabilities and payoffs can be the result of the forces of the marketplace. They, however, are not the only cause. Others, such as social norms and even the laws of probability, may also be able to produce a risk-reward relationship. Although the risk-reward relationship is obvious to the financial community and laypeople alike ("no risk, no reward!"), descriptive theories of risky choice have largely ignored it. We posit that while reckoning with uncertainty—situations where the risks or probabilities of

outcomes are not known or provided—people may in fact exploit this ecological relationship in the form of a heuristic, the *risk-reward heuristic*, which states that under uncertainty the probabilities can be inferred from the magnitude of the rewards. Next, we examined if and how people use the heuristic (Pleskac & Hertwig, 2014). In these studies, participants were asked to estimate the probability of the occurrence of rewards of specific magnitudes. Consistent with the risk-reward heuristic, the number participants estimated was negatively related to the payoff. Moreover, the estimated number predicted choices. Participants who estimated a higher number were three times more likely to take the risk. We (Pleskac & Hertwig, 2014) further showed that such an adaptive use of the heuristic can help explain some age-old questions in the study of decision making. Take, for instance, the phenomenon that people prefer gambles with known risks (e.g., "Win \$100 if a red marble is drawn from an urn with 50 red

marbles and 50 black marbles") over gambles with unknown risks ("Win \$100 if a red marble is drawn from an urn with 100 marbles with an unknown proportion of red and black marbles"), even if the former would have a lower *expected* value. In this case, what appears to be an irrational bias for ambiguity aversion may in fact be an ecologically informed bet about the risks of an unknown option. Taken together, these findings suggest that theories of decision making need to model not only the decision process but also the recurrent environmental structures to which the processes are adapted.

### Theory Integration: Connecting Heuristics to Computational Models of Cognition

In psychology and economics, several formalized mathematical frameworks exist that allow researchers to map out hypothesized decision and other cognitive processes. Recent work has begun to elaborate the relationship between models of heuristics and prominent mathematical frameworks and has demonstrated how the former can be represented within the latter. One major benefit of such theory integration is that it demonstrates how the conceptual lenses of the different frameworks can be used as alternative routes to study heuristic principles of decision making. Moreover, it enriches researchers' conceptual nomenclature and tools in the study of bounded rationality. In what follows, we show three ways to achieve theory integration of models of heuristics with other important cognitive and economic frameworks.

#### *Heuristics Within the Cognitive Architecture ACT-R*

Simple heuristics have commonly been described using sequential processing steps that indicate the search, stopping, and decision operations that are directly involved in the decision-making process (e.g., search cues in order of validity, stop search as soon as a cue discriminates). Although this makes it transparent how information is searched for and what information is being used, this description does not specify how the processes recruit other cognitive functions, such as long-term memory retrieval and working-memory

updating. Toward a better understanding of how the different cognitive functions interact during the process of executing a heuristic, we (Fechner et al., 2016) developed models of various heuristics using the ACT-R (adaptive control of thought-rational) architecture, and so building on Schooler and Hertwig (2005). ACT-R is an integrated theory of cognition and a modeling environment that has been applied to a wide range of human behaviors. ACT-R models consist of a set of production rules and declarative knowledge that interact with core modules representing the various cognitive functions.

Using this framework, we (Fechner et al., 2016) formalized three candidate strategies for memory-based decision making about objects: one strategy that relies solely on recognition memory (namely, how speedily an object is recognized), a second strategy that retrieves additional knowledge, and a third, lexicographic (i.e., sequential) strategy that considers knowledge conditionally on the evidence obtained from recognition memory (e.g., depending on whether the speed of recognition differed between two objects). The ACT-R models specify to what extent each strategy recruits various cognitive functions, thus rendering it possible to derive response time predictions. In addition, because the activity of ACT-R's core modules has been mapped to different regions in the brain, we were able to derive predictions for the various strategies in terms of blood-oxygen-level-dependent (BOLD) responses. The predictions were then compared to the results of an fMRI study in which participants were asked to infer which of two alternative scores higher on a quantitative dimension. Overall, versions of the lexicographic strategy—according to which knowledge about many, but not all, alternatives is searched—provided the best account of the joint patterns of response times and BOLD responses. These results highlight the usefulness of implementing models of decision making within a cognitive architecture to thus derive predictions on the behavioral and neural level. This theory integration also renders it possible to model the interplay between recognition and additional knowledge in memory, indicating the adaptive

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use of these two sources of information in decision making. We (Khader, Pachur, Weber, & Jost, 2016) further connected heuristic decision making with prominent concepts of memory functions by empirically disentangling the operation of controlled and automatic memory-retrieval processes during people's use of the take-the-best heuristic. To that end, we combined a paradigm developed to examine neural correlates of selective and sequential memory retrieval in decision making with a manipulation of associative fan (i.e., the decision options were associated with one, two, or three attributes). The results show that both the automatic activation of all attributes associated with a decision option as well as the controlled sequential retrieval of individual attributes can be traced in the specific brain areas in which the respective attributes (which consisted, i.e., of objects or faces) are represented. Moreover, as predicted by ACT-R, the two facets of memory retrieval were associated with distinct activation patterns within the frontoparietal network: The dorsolateral prefrontal cortex was found to reflect increasing retrieval effort during both automatic and controlled activation of attributes. In contrast, the superior parietal cortex responded only to controlled retrieval, arguably reflecting the sequential updating of attribute information in working memory.

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#### *Heuristics Within a Quantum Theoretical Framework*

The use of ACT-R to model simple heuristics illustrates an unexplored assumption behind research on simple heuristics, namely, the appropriateness of using classic information-processing theory to formally describe the heuristics. That is, the cues the heuristics recruit are described in terms of deterministic bits of information—typically in binary form (e.g., a city either has a soccer team or not)—and classic logic operators (e.g., AND, NOT, OR gates) are used to transform the cue values into a decision. We (Kvam & Pleskac, 2016) demonstrated that the use of classic information-processing theory as a basis to formalize the heuristics produces some interesting consequences. Typically, it results

in the heuristics making deterministic choices, processing information serially, and only using cues with known values. Yet, each of these processing characteristics is inconsistent with the evidence that decision making is stochastic rather than deterministic; the evidence that strategies can involve parallel processing of cues; and that uncertainty of knowledge has a systematic impact on the decision-making process.

However, as we argued, these properties are not necessarily those of the heuristic itself but stem from the information theory used to formally describe the heuristic. With this in mind, we (Kvam & Pleskac, 2016) examined an alternative information theory for modeling heuristics, using quantum theory. Rather than using bits, quantum logic represents pieces of information as *qubits*. Whereas a bit can only be in either one of two states, a qubit can exist in a continuous superposition between those states. This superposition (or indefinite state) provides a means for capturing the uncertainty a decision maker might have regarding, for instance, whether a particular cue is present or absent. A second property of quantum theory is that it directly models how measurements such as making a decision or asking people to report the value of a cue impact the state of the information-processing system.

We (Kvam & Pleskac, 2016) showed how these quantum properties, combined with quantum operators that work similarly to classic operators, provide a framework for simple heuristics that makes it possible to represent how they can give rise to stochastic choice, how their processing can be serial or parallel, and how they can be used even when there is uncertainty about cue values. At the same time, quantum information theory also benefits from this theory integration. Specifically, quantum information theory is indifferent to how particular processing strategies are assembled and thus alone does not offer an explanation of behavior. Simple heuristics (such as take-the-best) provide a principled structure for quantum information theory to implement. This structure offers attractive properties such as heuristics that can enlist the structure of the environment to thus make

inferences without the prohibitive computational costs of estimating the covariance matrix between the cues and the criterion. Thus, integrating the two approaches benefits both. Equally important, however, is that this instance of theory integration permits new testable predictions. For instance, it predicts order effects: Accordingly, forcing someone to report the value of a cue before making a decision should impact the decision. Further, it also provides a process explanation for the hindsight bias, as it predicts that learning the criterion value of an object may (via the quantum property of entanglement) impact the (uncertain) state of the object's cue values.

#### Heuristics Within Cumulative Prospect Theory

Algebraic models of risky choice, such as expected utility and expected value theory, focus on the algebraic patterns of people's risk preferences and thus on people's ultimate choices, but not on how the choices come about. Models of heuristics, by contrast also focus on the content (rather than just the result) of choice processes and are explicated in terms of the assumed operations, such as search, stopping, and integration of information. Because they rest on fundamentally different assumptions and algorithms, models of heuristics and algebraic choice models are usually treated as antithetical or even incom-

measurable. Drawing on cumulative prospect theory (CPT) as the currently most influential descriptive algebraic model, we (Pachur, Suter, & Hertwig, 2017) demonstrated how the two modeling traditions can be linked. CPT's value and weighting functions characterize choices in terms of psychophysical constructs, such as diminishing sensitivity to probabilities and outcomes, as well as psychological constructs, such as risk aversion and loss aversion. Models of heuristics capture choices as emerging from simple information-processing principles, such as lexicographic and limited search. Using computer simulations, we (Pachur et al., 2017) estimated CPT's parameters for choices produced by various heuristics that differ in the extent to which they pay heed to probability information. The resulting CPT parameter profiles are shown in Figure 3. These profiles portray each of the choice-generating heuristics in psychologically meaningful ways. For instance, differences between the heuristics in how frequently they inspect probability information are captured by systematic differences in CPT's weighting function: Heuristics that completely ignore probabilities (e.g., the minimax heuristic) produced a more strongly curved weighting function, indicating very low sensitivity to differences in probability, than heuristics that attend to probabilities (e.g., the priority heuristic, the most-likely

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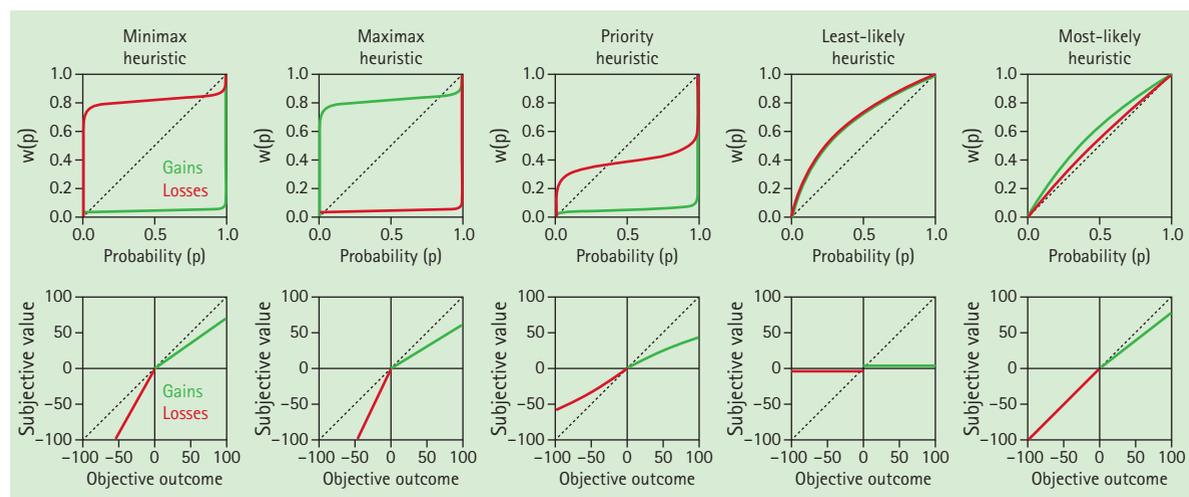


Figure 3. Cumulative prospect theory's weighting function (upper row) and value function (lower row) estimated for the choices of five heuristics for problems with two-outcome gambles (adapted from Pachur, Suter, & Hertwig, 2017).

heuristic). That is, the probability weighting function meaningfully reflects key aspects of the heuristics' information-processing character. Furthermore, we showed that CPT is also able to track the interaction between the heuristics and choice ecologies. To illustrate, in environments in which there is a negative correlation between risks (i.e., probabilities) and rewards (i.e., outcomes; see above subsection "Heuristics and the structure of the environment") the most-likely heuristic leads to risk aversion for gains and to risk seeking for losses, as indicated by the elevation parameter in CPT's weighting function; in

uncorrelated environments, by contrast, the heuristic is risk neutral. Overall, this third instance of theory integration offers benefits to both models of heuristics and CPT. Heuristics can be characterized and compared in terms of the constructs of algebraic models, such as risk aversion, loss aversion, and probability sensitivity. Conversely, heuristics suggest a novel and unexplored cognitive foundation of CPT, namely, that the shapes of its functions may stem, at least in part, from distinct heuristic principles of information processing.

## Research Area 2: The Exploring Mind

Exploration or search is a quintessential method for solving problems. In fact, one might argue that the way humans search to solve problems is one way they achieve their intelligence. The Center has been studying these search-based achievements in the context of two specific problems: when people make decisions under uncertainty and have to rely on their experiences to make a choice and when they assess their own uncertainty (or confidence) in the decisions they have made. At the same time, we have also been exploring a novel perspective, asking, in what situations do individuals choose not to search out any information and instead remain ignorant (something we call *deliberate ignorance*)?

### Decisions From Experience

Decisions made under uncertainty are, of course, all around us. These are decisions such as whether to invest in the stock market, what type of medical treatment to receive, or whether to cross the street. In all these decisions, people lack precise knowledge of the possible consequences of their actions and are thus faced with the problem of identifying the possible outcomes and their likelihoods. One solution is for people to actively explore the possible options to form an impression of the possible outcomes and their likelihoods and then make a decision based on these experiences. We call this solution *decisions from experience*. Our group has helped to establish that decisions made from experience are systematically different from the decisions people would make between the same options, but with definite knowledge of their possible outcomes and their likelihoods, a description–experience gap (Hertwig, 2015).

Our initial studies in this area have focused largely on comparing decisions from experience to decisions from description using simple monetary lotteries, such as the choice between a lottery that offers an 80% chance to win €4 and one that offers €3 for certain. Participants either learned about the options via written descriptions or were presented with only—typically two—buttons on a computer screen. Clicking the button produced a random draw from the specified payoff distributions, thus allowing participants to explore these options to form an impression from experience. Comparing these different types of choices has shown that a description–experience gap tends to occur because, if an option has a rare event, this possibility seems

to have less impact on the observed choice in decisions from experience than with description. That is, in decisions from experience, people seem to choose as if they underweight rare events. This occurs partly because people rely on small samples, and in such samples people are less likely to experience the rare event (relative to its true underlying probability; Hertwig, 2015) but also partly due to differences in how people learn and decide (Pleskac, 2015b).

Our goal in further examining decisions from experience has been fourfold. First, we asked to what extent the description–experience gap generalizes to domains beyond simple monetary lotteries. Second, we examined experience-based choice and search in social contexts (rather than in the common solitary context). Third, we made progress toward a framework of experience-based choice that seeks to simultaneously model search and choice during decisions from experience. Fourth, we aimed to better understand how invariant the subjective representations of described and experienced risks (i.e., decision weights) and rewards (i.e., values) are.

### *The Description–Experience Gap Beyond Monetary Gambles*

To find out the extent to which the description–experience gap persists outside the domain of simple monetary lotteries, we have investigated the description–experience gap with decisions about medical treatments, investment decisions with stock market performance indicators, and consumer decisions based on online product reviews. In all cases, we have found that the description–experience gap persists. Furthermore, it often arises for the same reasons, such as people

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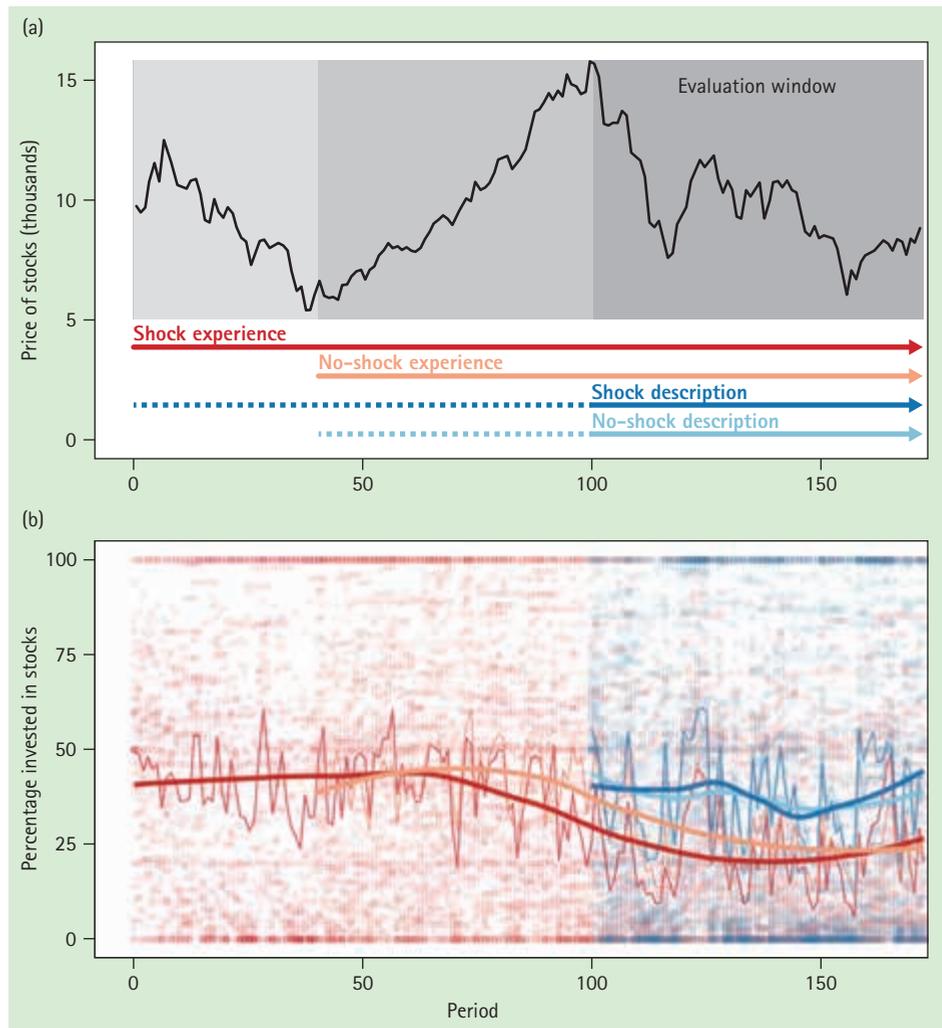
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basing their decisions on small samples and relying heavily on their most recent experiences. Extending our investigations to these new domains has also revealed new implications of the description–experience gap. Consider, for example, Figure 4a, showing the development of the Spanish stock index price (IBEX-35) from July 1999 to September 2013 (172 monthly periods). It shows two macro-

economic shocks: one from 1999 to 2002, with a 57% drop in stock price, and the other occurring between 2007 and 2009, resulting in a 52% drop. Now consider the different ways potential investors can learn about these shocks. Some might learn about them from graphs, such as the one in Figure 4a describing the events, while others might have lived through these shocks and experienced these events. Do the different modes of

### Key Reference

Lejarraga, T., Woike, J. K., & Hertwig, R. (2016). Description and experience: How experimental investors learn about booms and busts affects their financial risk taking. *Cognition*, 157, 365–383. doi:10.1016/j.cognition.2016.10.001



**Figure 4.** Investment decisions with stock market performance indicators. (a) The black line in the upper panel shows the price of the Spanish stock index, the IBEX-35, across 172 monthly periods (from July 1999 to September 2013). Solid arrow segments indicate periods in which participants made actual investment decisions. Dotted arrow segments indicate those periods learned from a graph. Investment decisions for the four conditions (shock experience, no-shock experience, shock description, no-shock description) were compared over the evaluation window from period 100 to period 172. (b) Percentage invested in stocks by condition (colors are analogous to the conditions displayed in [a]). Dots indicate individuals' allocations. The lines show the data smoothed by local polynomial regression fitting. See main text for details (adapted from Lejarraga, Woike, & Hertwig, 2016).

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learning about these events impact financial decision making? Or is it the case that, consistent with standard economic models, individual investors incorporate all available historical data, independent of representation and mode of learning, when forming beliefs about risky options?

To answer this question, we (Lejarraga, Woike, & Hertwig, 2016) asked participants in a simulated experimental stock market to sequentially decide between saving money in a cash account or investing in a stock index fund that tracked the price shown in Figure 4a. Some participants entered the market early and experienced the shock, while others entered later and only learned about the earlier shock from the graphical description (see conditions in Figure 4a). Figure 4b shows that the different ways to learn about historical data led to differences in investment behavior, echoing the description–experience gap: Those who learned about the market from personal experience took less financial risk than those who learned from graphical descriptions of the same data. Subsequent modeling and empirical work revealed that the description–experience gap was due to people in the experience condition being more risk averse, that is, more averse to variability. Thus, these results provide new psychological insights into how and why individual experiences of macroeconomic shocks affect financial risk taking.

#### *Decisions From Experience in Social Worlds*

When making decisions, people are often not solitary agents but act in the presence of others. What happens when two decision makers, one who has learned about prospects from description (e.g., a patient who reads about the side effect of a treatment option) and another who has learned from experience (a doctor who has seen the side effects or lack thereof in his or her patients), have to make a joint decision? Given the description–experience gap, how these two people make decisions can have important consequences in terms of how events with a small probability of occurrence (rare events) figure in the final decision. To investigate this question, we (Lejarraga & Müller-Trede, 2016) randomly

paired two participants: One learned about a risky prospect from experience and the other from description. What we found over a series of studies is that their joint decisions tended to show neither over- nor under-weighting, but a weight more equivalent to the outcomes' objective probabilities. That is, the social interaction thus leads dyads to make shared decisions that follow normative standards more closely than the decisions made by individual decision makers. Such a result is fascinating as it suggests decision makers can potentially reap great rewards by creating opportunities for experience to meet description.

Search is key to experience-based choice. A particular challenge any organism faces is how much to search before making a choice. On this front, we have identified several factors that determine how much people search. For instance, we have found that age and short-term maximization goals can prompt limited search, whereas the presence of losses and putting people in a fearful state prompts greater search. Furthermore, one key factor that shapes search is social competition. We (Phillips, Hertwig, Kareev, & Avrahami, 2014) showed that when making decisions from experience in the presence or absence of competitors, people *should* and indeed *do* limit their search. In fact, in some situations they should and do take as few as one or two samples before acting. While this hasty action means decision makers forego information, these first movers do better than those who explore more in a competitive situation.

Although these extremely small samples can have advantages for the individual, this hasty search can have disadvantages at the population level. To see this, we (Hintze, Phillips, & Hertwig, 2015) asked how simulated agents making these types of decisions from experience would evolve across generations with these different levels of competition. We found what we portrayed as the “Janus face of competition” (see Figure 5). Agents who faced a mild level of competition sampled more and evolved decision strategies that improved their own fitness. These decision strategies also benefited the entire population by giving rise to a sampling strategy

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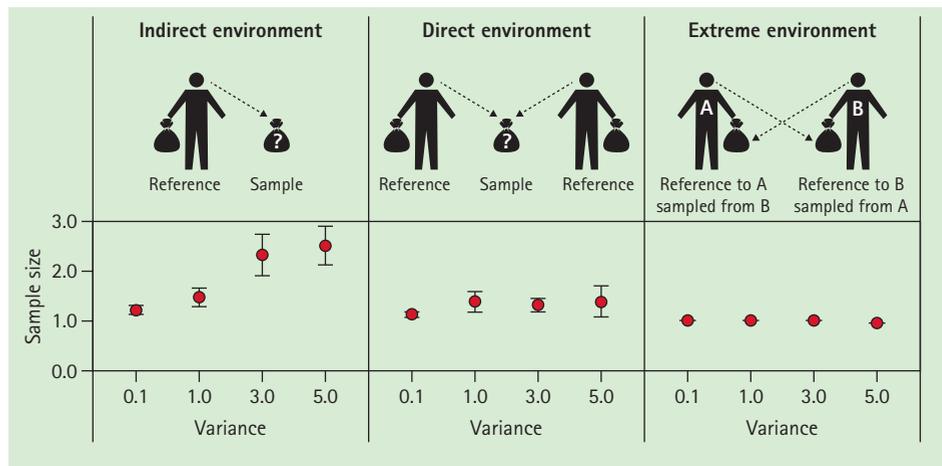


Figure 5. The "Janus face of competition." Average number of samples the representative agents took, for each of the three environments. Each environment was tested using four different variances of the distribution of the urns. The error bars indicate two standard errors. (1) In the indirect environment (left), the agent, due to sufficient sampling in the past, knows the value the reference urn holds. The agent can sample from the unknown urn and chooses the urn with the higher payoff. (2) In the direct environment (middle), both agents compete over the same unknown urn, while knowing the value of their own reference urn. (3) In the extreme environment (right), both agents sample from each other's urn, and can select the opponent's urn, leaving their own urn to the opponent (adapted from Hintze, Phillips, & Hertwig, 2015).

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that would persist in the population. Under extreme competition, however, agents reduced their search so that they were not able to evolve cognitively sophisticated decision strategies, which negatively impacted the fitness of the population (see Figure 5, "extreme environment"). These simulations suggest that modest competition is therefore a positive driver for the evolution of cognitive abilities and beneficial for the population as a whole, whereas too much competition is devastating both for the development of cognitive sophistication and for the population.

#### *Toward an Integrative Framework of Decisions From Experience*

Extant models of decisions from experience have focused more on the choice process and less on search. To make progress toward an integrative approach, we have initiated a new line of work. It seeks to simultaneously model search and choice during decisions from experience (Markant, Pleskac, Diederich, Pachur, & Hertwig, 2015). In this work, we have developed a new model—Choosing from Accumulated Samples of Experience (CHASE)—that

describes sampling and choice behavior during decisions from experience as a sequential sampling process. According to CHASE, as people sample information from their possible options, they evaluate the samples in terms of their relative value for either option. These evaluations are accumulated over time, leading to changes in preference for the possible options. Once a threshold level of preference is reached, sampling stops and a choice is made (see Figure 6). With these process assumptions, CHASE predicts both how much people will sample and the choice they will ultimately make. Using several extant data sets, we have shown that this model provides a good account of choice and sampling behavior, outperforming other leading models of decisions from experience.

One important property of CHASE is that it shows how the thresholds people set shape their choice behavior and, in particular, influence the impact rare events have on their choices. If people are, in principle, overly attentive to rare events, then with larger choice thresholds participants will make choices that appear to overweight rare events, thus

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Markant, D. B., Pleskac, T. J., Diederich, A., Pachur, T., & Hertwig, R. (2015). Modeling choice and search in decisions from experience: A sequential sampling approach. In R. Dale, C. Jennings, P. Maglio, T. Matlock, D. Noelle, A. Warlaumont, & J. Yoshimi (Eds.), *Proceedings of the 37th Annual Conference of the Cognitive Science Society: Mind, technology, and society* (pp. 1512–1517). Austin, TX: Cognitive Science Society.

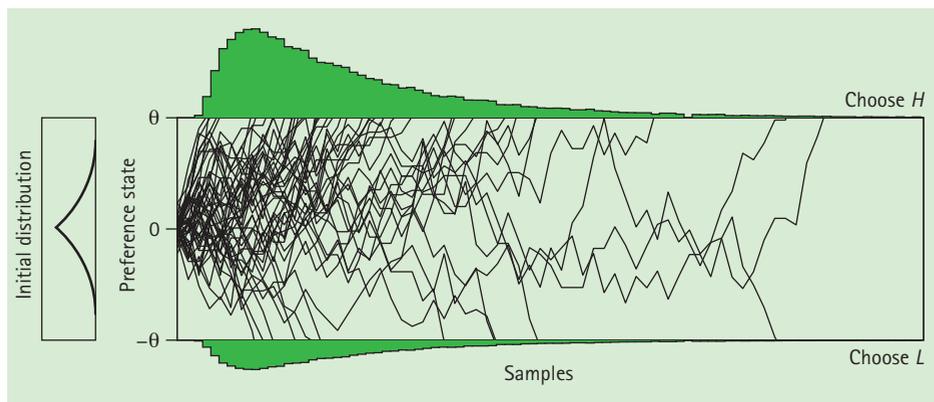


Figure 6. Illustration of the Choosing from Accumulated Samples of Experience (CHASE) model. The observed samples are evaluated in terms of their relative value for either option and lead to change in preference for either the higher (*H*) or lower (*L*) expected value option. Once a threshold level of preference is reached ( $\theta$  or  $-\theta$ ), sampling stops and a choice is made. Thus, the model predicts both the choices and people's sample sizes for a given problem (adapted from Markant, Pleskac, Diederich, Pachur, & Hertwig, 2015).

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giving rise to an inverse-shaped function, as we also found (see subsection "How does the description–experience gap map onto subjective representations of risks and rewards?" below). However, if these same people move their thresholds in (perhaps reflecting the costs of sampling or other factors such as their emotional state), then they will make choices that appear to underweight rare events.

We aim to continue to develop CHASE to understand how people effectively search and make choices under uncertainty, but we also plan to examine other decision strategies for making decisions from experience. We have, at the same time, been looking back at the extant work in the literature and have completed a meta-analysis that examines the description–experience gap over the past years, which has both helped to establish the robustness of the gap as well as reveal new insights. We also have begun to explore other areas where a description–experience gap may be at play, such as in intertemporal choice and probabilistic reasoning. With regard to probabilistic reasoning, a description–experience gap may help clarify why adults look incompetent in reasoning about probabilities while babies and chimps appear so smart.

#### *How Does the Description–Experience Gap Map Onto Subjective Representations of Risks and Rewards?*

With the enormous impact of cumulative prospect theory (CPT), the assumption of an inverse S-shaped probability weighting function has become widely accepted as a cut-and-dried fact. It is perhaps against this background that the conclusion of a reversed probability weighting in experience-based choice has piqued researchers' interest. It is important to note that the early analyses of the description–experience gap inferred the possible probability weighting from people's choices. That is, the conclusion of underweighting of rare events was not derived from estimating a weighting function conditioned on the actually experienced relative frequencies. In recent years, researchers have begun to quantitatively measure the decision weights in experience and to examine whether decision weights that are attached to the relative frequencies that people *experience* (rather than the objective probabilities) are any different from those attached to stated (described) probabilities. It is important to note that even if description- and experience-based decision weights were similar or even identical, choices could still be systematically different. Previous analy-

#### Key Reference

Kellen, D., Pachur, T., & Hertwig, R. (2016). How (in)variant are subjective representations of described and experienced risk and rewards? *Cognition*, 157, 126–138. doi:10.1016/j.cognition.2016.08.020

ses have produced rather mixed results. We (Kellen, Pachur, & Hertwig, 2016) improved on these analyses by taking advantage of both a within-subjects design and a hierarchical Bayesian implementation of CPT. We found that relative to decisions from description, decisions from experience showed reduced sensitivity to probabilities and increased sensitivity to outcomes. For some CPT parameters, individual differences were relatively stable across both modes of learning. Our results suggest there is no evidence for an S-shaped probability weighting function with regard to experienced relative frequencies, and yet, outcome and probability information translate into systematically different subjective representations in description- versus experience-based choice. At the same time, both types of decisions seem to tap into the same individual-level regularities.

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**Yu, S., Pleskac, T. J., & Zeigenfuss, M. D. (2015).** Dynamics of postdecisional processing of confidence. *Journal of Experimental Psychology: General*, 144, 489–510. doi:10.1037/xge0000062

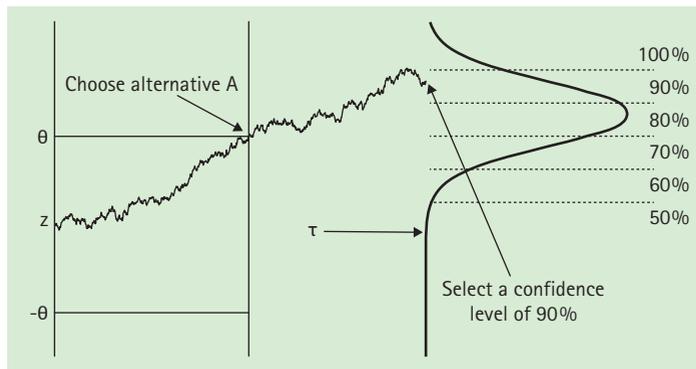
### Confidence and Search in the Mind

Our second line of work on the exploring mind has focused on how people assess the confidence in their decisions. The standard assumption is that the confidence people have in their decisions reflects their state of mind at the time of their decision. Our work has shown that this single-state-of-mind assumption is not quite right. Instead, after making a choice, people appear to continue to process

information on the original choice options. In this postdecisional process, people use this additional information to assess their confidence in their choices. This means that confidence does not necessarily reflect the state of mind at the time of a choice.

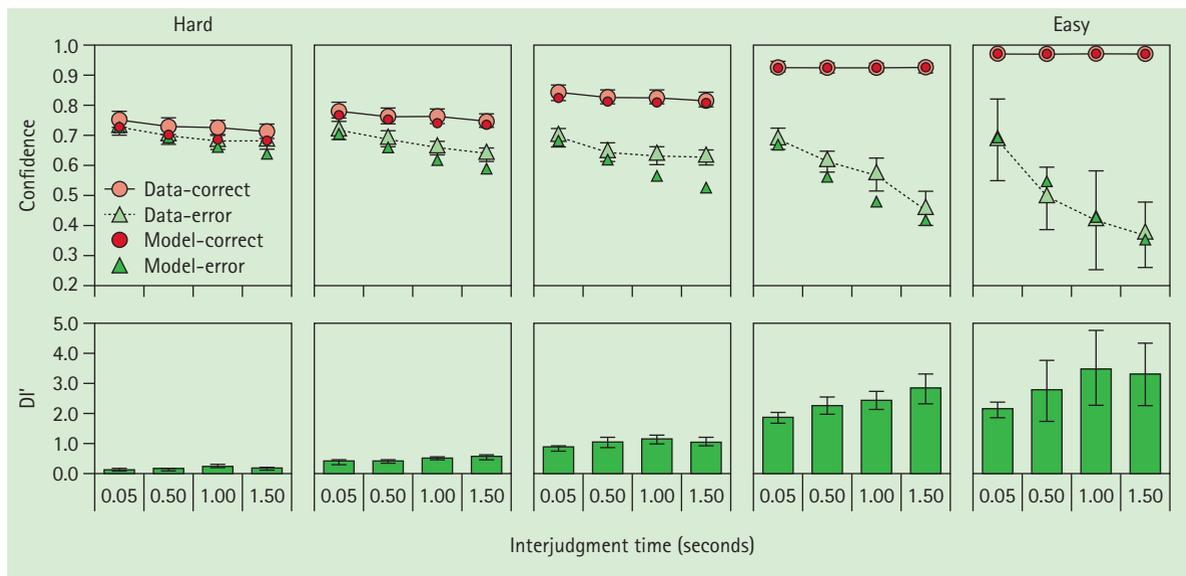
This result and hypothesis were formalized in what we call two-stage dynamic signal detection theory (2DSD; Pleskac & Busemeyer, 2010). According to 2DSD, to make a choice, people sequentially sample information about the possible alternatives and integrate that information over time as evidence accumulates. Once an evidence threshold has been reached, a decision is made accordingly (see left side in Figure 7). This basic drift-diffusion process gives a good account of choice and response-time data. In fact, the basic theoretical structure is related to the CHASE model described earlier (see above subsection “Toward an integrative framework of decisions from experience”) but with some important differences. First, in the case of 2DSD and other models of choice and response times, the sampled evidence is not observed externally (e.g., from the payoff distributions in decisions from experience), but occurs in the mind. Second, sampling occurs over continuous time, whereas CHASE models the discrete sample size. Another difference is that in the 2DSD model, evidence continues to accumulate after a choice (i.e., postdecisional processing). According to 2DSD, when a confidence judgment is requested, respondents categorize the total accumulated evidence (i.e., before and after the decision) into a confidence rating. Thus, according to 2DSD, the accuracy of confidence judgments is contingent on both the quality and quantity of evidence accumulated pre- and postdecision.

We (Yu, Pleskac, & Zeigenfuss, 2015) empirically tested a critical prediction of 2DSD. As more time passes between making a choice and a confidence judgment, more evidence will be accumulated. This will lead to confidence judgments changing over time in a way that they better reflect the true state of the world. To examine this prediction, we asked participants to make a series of perceptual or inferential decisions about which of two options scores larger on a quantitative dimen-



**Figure 7.** According to two-stage dynamic signal detection theory, to make a decision, people accumulate evidence over time. The jagged line represents the accumulated evidence at a given point in time. When evidence reaches a threshold ( $\theta$  or  $-\theta$ ), a choice is triggered (e.g., alternative A). After a choice is made, decision makers continue to accumulate evidence, and when a confidence judgment is cued (after an interjudgment time  $\tau$ ), they map the location of the evidence to a confidence rating (adapted from Pleskac & Busemeyer, 2010).

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**Figure 8.** How confidence changes over time during a perceptual decision for different levels of difficulty in discriminating between the correct choices from hard (left-most panel) to easy (right-most panel). The top row shows that the effect is asymmetrical in that the change is greatest for errors. The asymmetric change in confidence over time for correct and incorrect decisions is inconsistent with participants seeking out confirmatory evidence. Instead, a two-stage dynamic signal detection model that assumes people continue accumulating new information while the older information decays away gives a good account of the data. The bottom row shows that this change in confidence is sufficient to improve the resolution of confidence, that is, the ability to discriminate correct from incorrect choices as measured by  $D'$  (i.e., standardized difference between confidence in correct vs. incorrect decisions) (adapted from Yu, Pleskac, & Zeigenfuse, 2015).

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sion (e.g., city populations). After each decision, people rated their confidence. Between trials, we manipulated how much time passed between the choice and confidence judgment. Typical results for a perceptual decision are shown in Figure 8. With more time between choice and confidence judgment (even just 1 second), confidence changed systematically such that, in general, the resolution of confidence judgments grew with more time. That is, people's confidence increasingly distinguished better between correct and incorrect decisions.

These counterintuitive results suggests a very simple strategy for improving confidence accuracy: Take a bit more time before expressing your confidence. It is worth noting that despite over 50 years of research trying to understand how people make confidence judgments and how to improve their accuracy, this simple strategy has never been proposed or investigated. It could, perhaps, be used as a simple method to boost the accuracy of forecasters.

We have also started to use 2DSD to better understand the nature of the evidence people accumulate to make choice and confidence judgments as well as the very nature of the evidence accumulation process itself. In particular, we (Kvam, Pleskac, Yu, & Busemeyer, 2015) have capitalized on this continued evidence accumulation (between choice and confidence judgment) to better understand the underlying cognitive process, examining if decision processes might be modeled as a quantum process. All current models of this process of evidence accumulation, such as 2DSD, are derived from classic stochastic theories. This means that information accumulates by moving across definite levels of evidence, carving out a single trajectory across these levels over time (see for illustration Figure 7).

In contrast, quantum decision models assume that at the cognitive level, evidence at any particular time is not in a definite but rather an indefinite (or superposition) state across levels of evidence. Judgments and decisions

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**Kvam, P. D., Pleskac, T. J., Yu, S., & Busemeyer, J. R. (2015).** Interference effects of choice on confidence: Quantum characteristics of evidence accumulation. *Proceedings of the National Academy of Sciences (USA)*, 112, 10645–10650. doi:10.1073/pnas.1500688112

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Hertwig, R., & Engel, C. (2016). Homo ignorans: Deliberately choosing not to know. *Perspectives on Psychological Science*, 11, 359–372. doi:10.1177/1745691616635594

are measurements by which a definite state of evidence is created from this indefinite state. Yet, if people continue to deliberate after a choice, the cognitive system enters back into an indefinite evidence state. This constructive process implies that interference effects should arise when multiple responses (measurements) are elicited over time such that making a decision changes subsequent distributions of confidence relative to when no decision is made. Models based on classic stochastic theories predict no effect of decision on the confidence ratings. In a critical experiment pitting these two a priori predictions against each other, we (Kvam et al., 2015) found such an interference effect during a simple perceptual discrimination task such that confidence judgments were less extreme and more accurate than when no decision was elicited. These results provide qualitative and quantitative support for a quantum process of evidence accumulation.

The next steps in understanding how people solve the problem of assessing their own uncertainty or confidence will be twofold. First, we are working to understand how this dynamic aspect of confidence can be used to improve the use of confidence judgments in areas of enormous applied value, such as eyewitness identification. Second, we aim to better understand and map out the information people use as they deliberate after their choice, with the hope of continuing to better understand the judgment and decision process.

## Mapping Deliberate Ignorance

Over the past few years, we have begun to investigate an alternative way for people to achieve their intelligence, one without search. That is, are there conditions under which people ought to choose to remain ignorant? Indeed people often choose not to know. Take, for instance, individuals at risk for Huntington's disease. Nearly everyone with the defective gene who lives long enough will develop this devastating condition. Yet only 3% to 25% of those at high risk opt to take a near-perfect test to identify if they are a carrier of the gene (Hertwig & Engel, 2016). Similarly, up to 55% of people who decide to be tested for HIV subsequently do not return to find out the result. We (Hertwig & Engel, 2016) have called the conscious choice not to seek or use knowledge (or information) *deliberate ignorance*. Using examples from a wide range of domains, we systematized types of deliberate ignorance (see Figure 9), described their functions, discussed their normative desirability, and considered how they can be modeled. Currently, in collaboration with a historian from the Technische Universität Dresden, in-depth interviews are being conducted with citizens who lived in the GDR and who suspect that the Stasi kept a file on them. Yet, they have decided not to find out whether such a file exists, let alone look it up. Why?

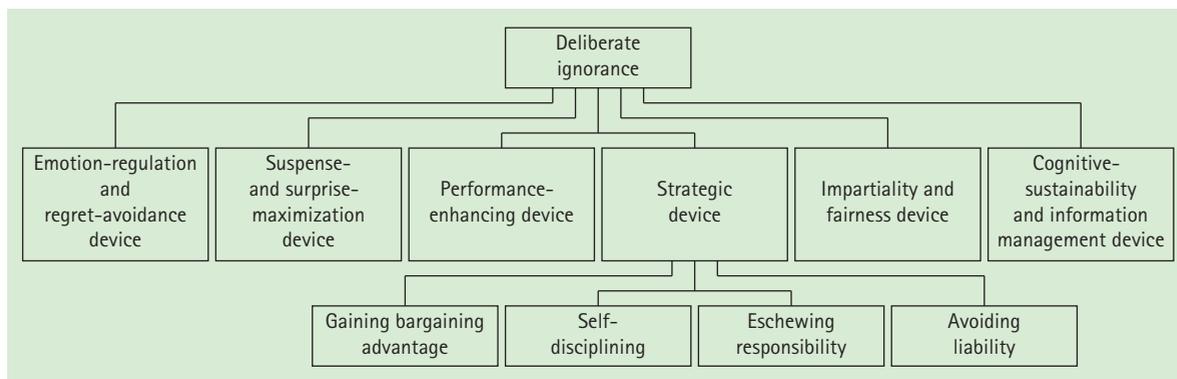


Figure 9. Map of types of deliberate ignorance (adapted from Hertwig & Engel, 2016).

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## Research Area 3: The Collective Mind

In an uncertain world, pooling distributed, incomplete, and uncertain knowledge boosts the power to make accurate judgments. Yet, sometimes being open to the influence of others also carries risks, such as that of forming a distorted representation of the environment. In what follows, we report on the work that the Center conducted to better understand (1) how people navigate physically crowded spaces with simple heuristics; (2) how collective dynamics shape people's notions of what threatens them (risk amplification); and (3) under what conditions it pays to join forces with others and when it is better to remain a solitary decision maker to achieve vital tasks such as medical diagnostics (boundary conditions of collective intelligence).

### Moving Together in Times of Adversity

Navigating in crowded urban areas is a complex cognitive task. Walking in a crowd requires one to continuously track the movement of other people, adapt one's own walking speed and direction to avoid collisions, and update the trajectory to the destination. Yet, simple navigation heuristics (e.g., "pass people on the right") allow pedestrians to navigate efficiently in this rapidly changing environment, often producing smart collective patterns that enhance traffic efficiency. Under stressful and extremely crowded conditions, however, the smooth coordination of the mass often breaks down. Every year, many lives are lost around the world due to crowd accidents, as illustrated by the series of dramatic accidents that have harmed people during the religious pilgrimage to Mecca in the past

decade. While the behavior of crowds under everyday conditions has been extensively studied, emergency situations remain poorly understood. It is unknown to what extent social factors, such as pushing and peer imitation, affect an emergency evacuation. The main obstacle is the scarcity of empirical data: Laboratory experiments are not suited for the study of emergency situations due to safety and ethical issues, and real-world observations of crowd accidents are rare and difficult to evaluate.

We (Moussaïd et al., 2016) tackled this issue in the laboratory with an innovative experimental method. We immersed a crowd of 36 participants in a three-dimensional virtual world (see Figure 10). Each participant physically sat in front of a computer screen and could control an avatar. Participants had a

### Key Reference

**Moussaïd, M., & Seyed Yahosseini, K. (2016).** Can simple transmission chains foster collective intelligence in binary-choice tasks? *PLoS ONE*, *11*(11):e0167223. doi:10.1371/journal.pone.0167223



*Figure 10.* Snapshot of the virtual environment during a simple evacuation procedure (Moussaïd et al., 2016). Each avatar in this snapshot was controlled by a real participant who had a first-person view of the surrounding environment.

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Moussaïd, M., Brighton, H., & Gaissmaier, W.

(2015). The amplification of risk in experimental diffusion chains. *Proceedings of the National Academy of Sciences (USA)*, 112, 5631–5636. doi:10.1073/pnas.1421883112

Moussaïd, M., & Trauernicht, M. (2016). Patterns of cooperation during collective emergencies in the help-or-escape social dilemma. *Scientific Reports*, 6:33417. doi:10.1038/srep33417

realistic first-person perspective on the surrounding environment. They could freely look around, navigate, and interact with the other participants in real time. Do virtual worlds constitute a good proxy for real-life behaviors, and, if so, what can be learned about stressful emergency evacuations? To address these questions, we first replicated in this virtual world a series of experiments that were previously conducted in real life. In the virtual environment, people exhibited behaviors that matched those observed in the analogous real-life situations. We showed, for instance, that social norms, such as pedestrians' tendency to avoid others on the right-hand side, reemerged in the virtual world.

Building on these replications of real-world regularities, we studied the behavioral dynamics of emergency evacuations. Participants were instructed to escape a burning building under time pressure. Failure to escape in time was penalized by a substantial loss of money. In this situation, body collisions and pushing increased quickly during the evacuation procedure. Participants imitated the navigation decisions of their neighbors, thus creating global herding patterns. This setup allowed the identification of dangerous zones where stampedes are likely to occur, such as places where decisions have to be made and areas surrounding bottlenecks.

Another component of safe evacuations is cooperation. During emergencies, the collective benefit of cooperation is important, but the cost of helping is high and the temptation to defect is strong. To study this dilemma, we (Moussaïd & Trauernicht, 2016) devised the help-or-escape game in which participants decided how much risk they were willing to take to help others. Under time pressure, participants could choose to escape quickly and reduce their risk of losing money or spend time helping others escape at the expense of their own chances to escape in time. Increased time and monetary pressure tended to amplify interindividual differences: Those who helped a lot under low-stress conditions tended to increase help when pressure was high, whereas those who were individualistic tended to become even more selfish under higher pressure. Overall, the experimental

methods we developed constitute promising tools for behavioral research and could help us understand mass movements and reduce the risks of accidents.

## Influencing and Being Influenced: How Judgments Propagate at Large Scale

People frequently rely on others to form judgments and make decisions. When judging the quality of a commercial product, evaluating the risks associated with a hazard, buying a house, or choosing a president, the influence of the social environment is omnipresent. The social environment is not static, but dynamic and responsive. It is, itself, composed of other individuals who adapt their own behavior to their own peers. This continuous interplay between the individual and the crowd gives rise to a variety of *collective dynamics* often characterized by amplification phenomena. For instance, in the domain of risk perception, people protecting themselves from a possible danger (e.g., people wearing masks in public places to avoid being infected by a virus) tends to increase the risk perception of external observers and incite them to adopt the same behavior. By doing so, the new adopters reinforce the social signal, creating a *snowball effect*: The more people adopt the behavior, the higher the probability that others will imitate them.

Despite important implications for our society, such social contagion phenomena are not yet well understood. We (Moussaïd, Brighton, & Gaissmaier, 2015) examined the dynamics underlying the propagation of risk judgments, such as people's attitudes toward nuclear energy, climate change, or terrorist threats. The goal was to analyze how a risk message detailing the benefits and harms of a controversial antibacterial agent called Triclosan is communicated from one individual to another through communication chains. A communication chain mimics the spread of a rumor in a social network: A first participant is "seeded" with a risk message providing information about Triclosan and is instructed to talk about this issue to a second, naïve participant. The second participant, in turn, is instructed to talk about Triclosan to a third individual, and so on until the 10th person in the chain.

The results revealed that risk judgments are indeed “contagious” and that repeated social transmissions generate risk amplification. During the discussions, participants tended to manipulate the original message they received to make it fit their preconceptions of the risk: Worried individuals primarily communicated the alarming aspects of the risk. Relaxed individuals, in contrast, tended to minimize its danger, thereby influencing the judgments of subsequent participants. Over repeated transmissions, the message became more extreme and participants’ judgments aligned with those of their predecessors (see Figure 11). This snowball effect is not without consequences: Computer simulations show that any preexisting judgment biases tend to become more extreme as people communicate.

### Collective Intelligence

Collective intelligence refers to the phenomenon that groups of individuals, by combining information, can often outperform the performance of single individuals and sometimes even surpass the performance of the best individual. But what are the boundary conditions of collective intelligence? In other words, how do the characteristics of the decision makers and the decision environment affect the ability of collectives to outperform single individuals?

In the United States alone, an estimated 200,000 patients die each year from preventable medical errors, including a large proportion of diagnostic errors. Reducing the frequency of diagnostic errors would thus represent a major step toward improving health care. Could collective intelligence be recruited in the service of this goal? Previous research on collective intelligence in medical diagnostics has yielded conflicting results, with some studies finding that group decision making boosts diagnostic accuracy and others finding nil or even detrimental effects. We believe the reason is that collective intelligence has been treated as a one-size-fits-all tool, without considering possible boundary conditions. We (Kurvers et al., 2016) investigated one key boundary condition, namely, similarity in individual decision accuracy between decision makers. Analytical modeling

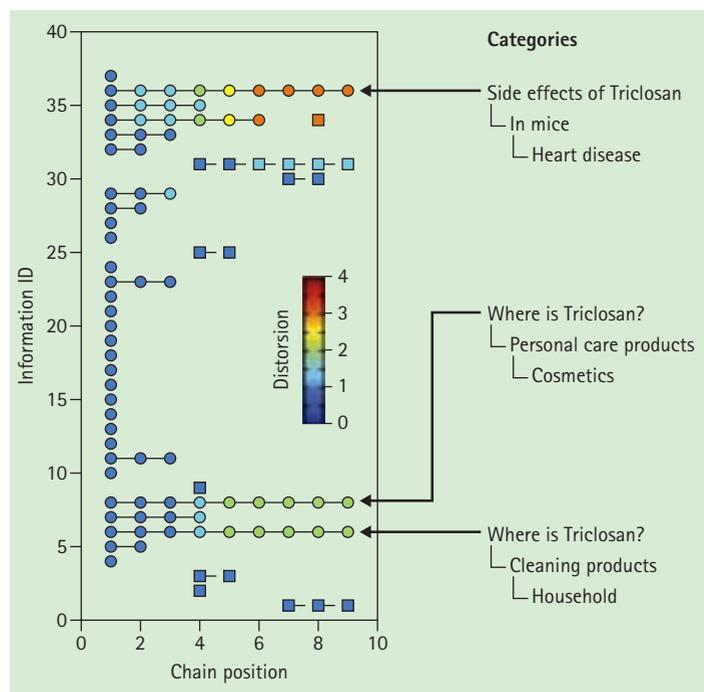


Figure 11. Topological map of information propagation in an experimental diffusion chain. Among all units of information available at chain position 1 (blue dots), only three have survived to the end of the chain—and they were strongly distorted. The text on the right-hand side describes the categories of these units of information. Seven units of information were introduced by the chain (squares), two of which survived to the end of the chain. The color coding indicates the cumulated content distortion of the information. Information identifications (IDs on the y-axis) are arbitrary (adapted from Moussaïd, Brighton, & Gaissmaier, 2015).

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showed that similarity in decision accuracy is a key condition for collective intelligence to arise: Whenever individuals have similar individual accuracy, combining their judgments allows the collective to outperform single individuals, including the best one. However, when individual accuracy levels of decision makers become too different, combining their judgments leads to worse performance compared to the group’s best individual. These predictions were subsequently tested in two important medical domains: breast and skin cancer diagnostics. For both domains, we used large data sets in which medical experts (radiologists and dermatologists) independently judged the same medical cases (mammograms and skin lesions) with regard to the presence of cancer. More than 140 doctors making more than 20,000 diagnoses were

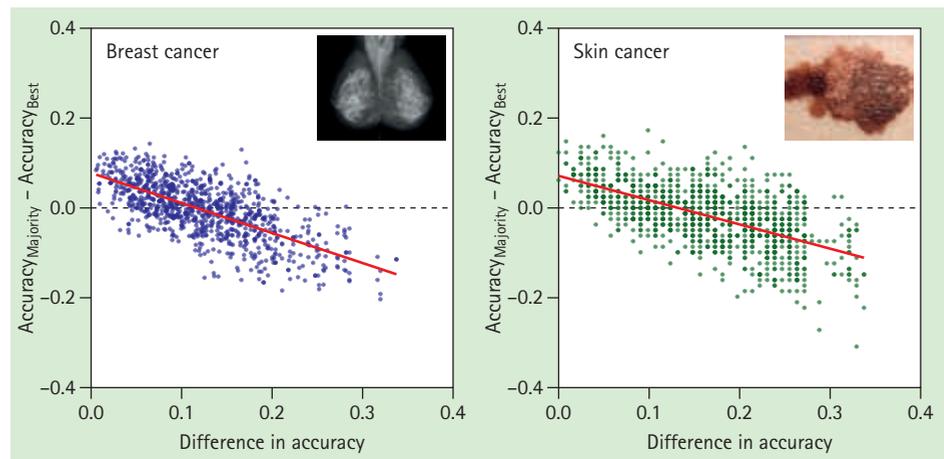
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included in this simulation study. Different virtual groups of doctors were composed whose decisions were combined using two well-known collective intelligence rules: the majority rule, which takes as final diagnosis the one receiving more votes, and the confidence rule, which takes as final diagnosis the one associated with the highest confidence level.

The analyses confirmed the theoretical predictions: When the decisions of doctors who were similar in diagnostic accuracy were combined, the collective performance was better than that of the group's best doctor

(see Figure 12). However, when the decisions of doctors with relatively noticeable differences in individual performance were combined, the collective performed worse than the best doctor. These results were highly robust across different group sizes, different collective intelligence rules, and with varying performance levels of the best doctor. We thus identified a key factor underlying collective intelligence. The results suggest recommendations as to when it is beneficial to combine the decisions of different decision makers (e.g., doctors) and when it is favorable to follow the group's best individual.



*Figure 12.* The boundary conditions of collective intelligence in breast and skin cancer diagnostics. Shown is the performance difference between the majority rule and the best doctor in a group as a function of the difference in individual accuracy levels between doctors. Each dot represents a unique combination of three doctors. Values above zero indicate that the majority rule outperformed the best individual in the group. Values below zero indicate that the best individual outperformed the majority rule. In both breast and skin cancer diagnostics, the majority rule outperformed the best individual only when the doctors' accuracy levels were relatively similar. Red lines show linear fits (adapted from Kurvers et al., 2016).

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## Research Area 4: The Unfinished Mind

Who runs the world? Judging from the average age of the first 20 people featured in the *Forbes* 2016 ranking of the *World's Most Powerful People* (65 years), political and economic power is concentrated in the hands of people who are, on average, considerably older than the general population. Older adults' overrepresentation in influential roles may be intensified in the future by demographic aging across the globe. Against this backdrop, the following questions are more pertinent than ever: Given that aging is associated with decline in many cognitive abilities, how does older adults' decision making compare with that of younger adults? Relatedly, how does the decision making of adolescents, a group particularly vulnerable in terms of morbidity and mortality compare with that of younger adults? In what follows, we report on the progress the Center made on these questions.

### The Development of the Preference for Risk Taking

The unexpected outcome of a 2016 referendum offered testimony to the fact that older and younger people's preferences can diverge. The British vote about the country's future relationship with the European Union revealed a split along an age line. The majority of voters in favor of exiting the European Union ("Brexit") were substantially older than those who voted to stay. Such age-dependent preferences can also—at least in theory—be traced back to possibly diverging risk preferences across the lifespan. Indeed, one area of change in decision making across the lifespan appears to be in the area of risky choice. In a meta-analysis of studies comparing younger and older adults on behavioral tasks thought to measure risk taking, Mata, Josef, Samanez-Larkin, and Hertwig (2011) found that age-related differences in risk attitude vary considerably with task characteristics, in particular, with learning requirements. Although this finding helped explain why studies focusing on decisions from description and decisions from experience resulted in quite different conclusions about younger and older people's risk appetite, this meta-analysis did not shed light on why the results of description-based studies pertaining to the impact of age varied widely.

#### *Disentangling Cognitive and Motivational Roots of Age Differences in Decisions Under Risk*

To reveal more of the dynamics and crucial task properties, we (Pachur, Mata, & Hertwig, 2017) aimed to disentangle age differences

on two key dimensions of decisions under risk—decision quality and risk attitude—and investigate their cognitive and motivational underpinnings. In addition, we mapped younger and older adults' risky choices using the cumulative prospect theory (CPT). CPT has frequently been used to hypothesize about age differences in decisions under risk, but no previous analysis has estimated CPT's value and weighting functions for younger and older adults' decisions under risk. We asked younger and older adults to indicate their preferences on two-option decision problems with monetary lotteries in gain, loss, and mixed domains. In contrast to most previous studies on age differences in risky choice, which often used a safe and a risky option, we primarily employed problems with two risky options. Consequently, when participants chose the safe option, this indicates that they preferred the lower risk and not simply the less complex option. The two age groups differed in both decision quality and risk aversion (see Figure 13). Importantly, these differences were differentially linked to age-related changes in cognition and motivation. First, the decision quality of older adults was lower than that of younger adults in the loss domain, and this age difference was attributable to decline in older adults' fluid intelligence and numeracy. Second, older adults chose the more risky option more often than younger adults in the gain and mixed domains; this was attributable to older adults' less pronounced negative affect. Modeling participants' risky choices with a Bayesian hierarchical implementation of CPT, we also found that older adults, relative to younger

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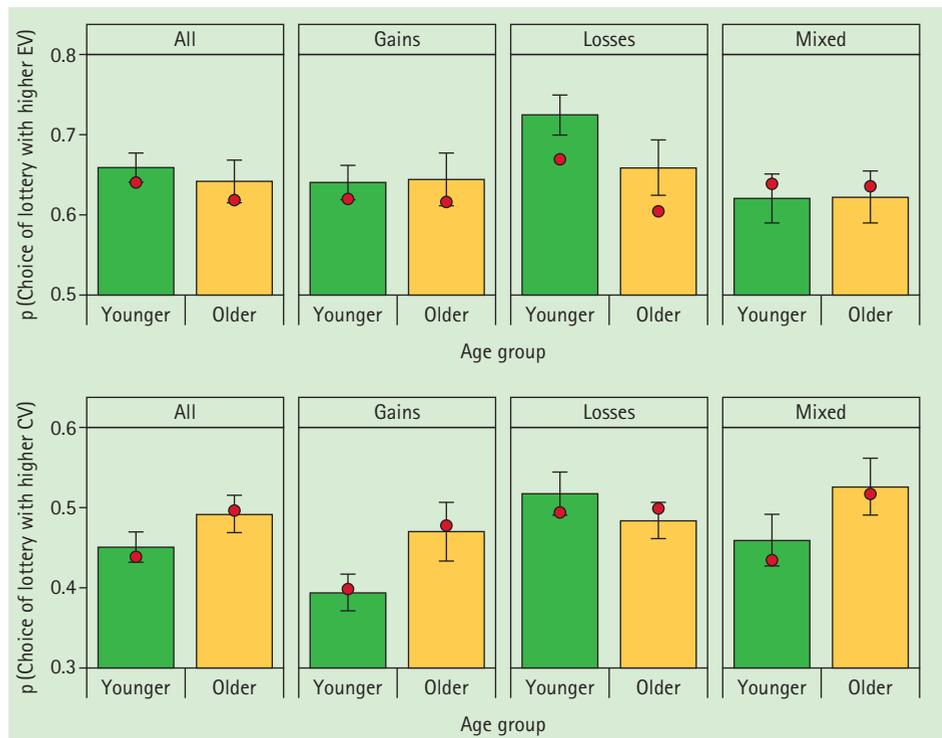


Figure 13. Average proportion of choices of the lottery with the higher expected value (EV; decision quality, upper panel) and the higher coefficient of variation (CV; risk aversion, lower panel), separately for the two age groups and each domain. Error bars indicate 95% confidence intervals. The red dots show the average (across participants) choice proportions derived from the cumulative prospect theory when using the mean (across individuals) estimated parameters (adapted from Pachur, Mata, & Hertwig, 2017).

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adults, had more optimistic decision weights for gains, showed no loss aversion, and had higher response variability (noise). Outcome sensitivity and probability sensitivity did not differ between the age groups. The results have several theoretical implications for explanations of older adults' risky choices. For instance, the lack of loss aversion in older adults suggests that motivational reorientation results in a positivity focus rather than loss prevention.

decisions from experience. Participants were permitted to search for information and learn about environmental contingencies by sampling from probabilistic payoff distributions (see also subsection "The exploring mind"). How do age-related declines in learning and memory affect people's appetite for information before making a final incentivized choice between the payoff distributions? Furthermore, do such differences in information search translate into poorer decisions from experience? Figure 14 illustrates respondents' search effort. When the choice environment was simple (i.e., with only two or four options), older and younger adults' appetites for information were nearly indistinguishable. Search effort, however, became vastly different as the number of options increased to eight: Then, older adults sampled fewer than 50 times, whereas younger adults sampled

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*Environmental Complexity and the Aging Mind*  
The analyses of both Mata et al. (2011) and Pachur et al. (2017) indicate that risk preferences between younger and older adults are more likely to differ the more cognitively taxing the behavioral task is. To examine this systematically, we (Frey, Mata, & Hertwig, 2015) asked younger and older adults to make

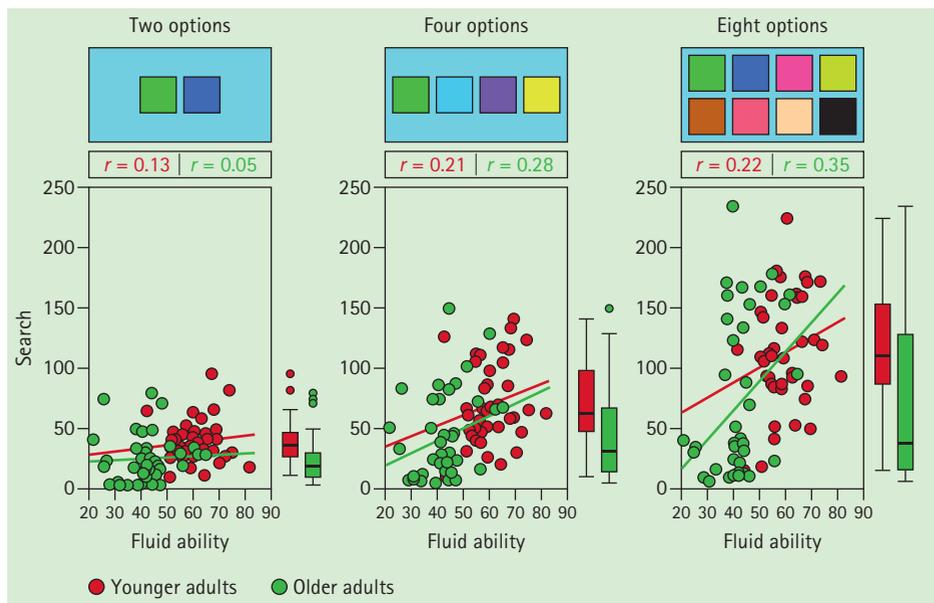


Figure 14. Relationship between fluid abilities and search effort, separately for younger ( $M = 25$  years old) and older ( $M = 71$  years old) adults, as a function of increasingly complex choice environments (i.e., decision problems with two, four, and eight options). Fluid cognitive abilities were measured using the digit-symbol substitution task (adapted from Frey, Mata, & Hertwig, 2015).

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more than 100 times. Furthermore, search was strongly correlated with fluid cognitive abilities. Yet, younger and older adults' choices did not differ substantially. Across all choice environments, younger and older adults chose in about 70% of cases the option that, based on their sampled experience, had the highest experienced sample mean. Indeed younger and older adults seemed to rely on similar and simple updating strategies (a delta-rule learning model), which may be relatively impervious to the effects of cognitive aging. To conclude, cognitive aging can, depending on the complexity of the choice environment, result in search differences between older and younger people. This, however, need not necessarily lead to less advantageous choices as long as the updating strategies work well.

#### Longitudinal Changes in Risk Attitudes Across the Lifespan

All the behavioral studies in Mata et al.'s (2011) meta-analysis of adults' age differences in risk preferences as well as our studies

have focused on cross-sectional comparisons, thus precluding the investigation of other conceptualizations of stability and change. To rectify this, we (Josef et al., 2016) engaged in a comprehensive longitudinal examination of self-reported risk preference. We drew on the unique longitudinal data set from the multicohort German Socio-Economic Panel Study to examine different conceptualizations of stability and change in risk-taking preference across the adult lifespan. The analysis included 44,076 individuals from 18 to 85 years of age (52% female) between 2004 and 2014. Three conceptualizations of stability and change were examined: *differential stability*, defined as consistency in the rank ordering of individuals over time; *mean-level stability*, defined as consistency in the average level of the trait over time and thus reflecting the trajectory of the aggregate behavior; and *individual-level stability*, defined as consistency of a trait at the level of the individual person.

The rich data set yielded numerous key results. First, risk preference can be understood

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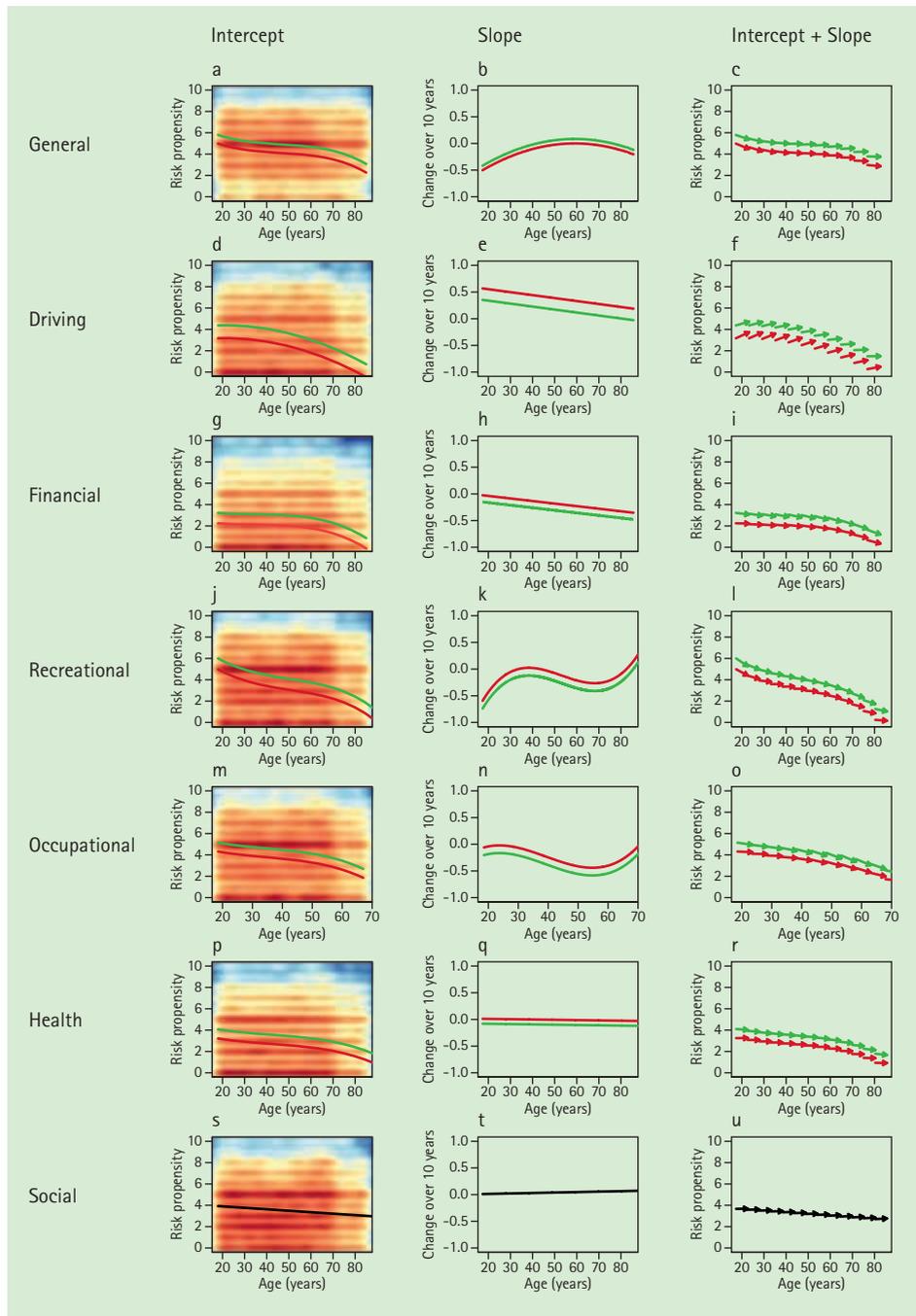
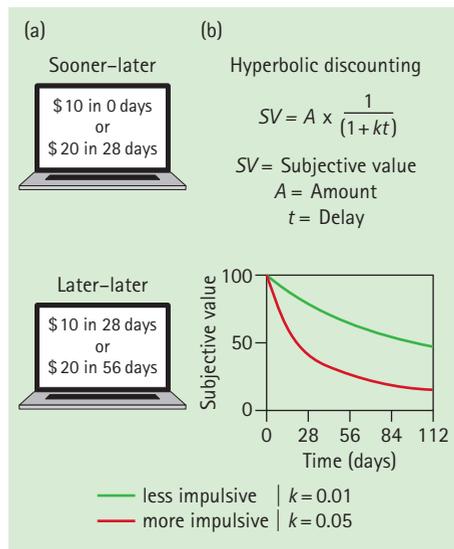


Figure 15. Age differences in self-reported risk preferences: mean levels (intercepts) and mean-level changes (slopes). Arrows (intercept + slope) represent a combined display of age differences in intercepts and slopes for 11 different cohorts. Red line = female; green line = male; single black line = no sex difference. All curves in the intercept plots (a, d, g, j, m, p, s) are plotted on a kernel density plot in which darker red colors indicate higher density of responses (adapted from Josef et al., 2016).

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Figure 17. (a) The intertemporal choice task. Participants are presented with two options, one smaller but sooner and one larger but later. In some cases, the smaller reward would be immediate, but sometimes it would also be in the future. (b) Hyperbolic discounting. These models assume that the value of an option decreases hyperbolically the more it is projected into the future. The crucial free parameter, the discount factor  $k$ , captures the degree of impulsivity a participant shows in the task (larger  $k$  being more impulsive).



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We (van den Bos, Rodriguez, Schweitzer, & McClure, 2015) applied a multimodal methodology to examine the psychological, neural, and hormonal influences on adolescent impulsiveness. We made use of the intertemporal choice paradigm (see Figure 17). This task abstracts a basic feature of real-life decisions, the trade-off between the timing and magnitude of rewards, and implements it in a simple decision task that can be understood by younger participants. It is also amenable to manipulation in an fMRI environment. The task presents the participants with a series of choices between a *small* reward that is received relatively *soon* (SS) and a *larger* reward that occurs *later* (LL). For instance, there is a relatively small reward in playing another hour of video games today, but this is traded off against the potential larger reward of getting a good test score at school a month from now.

On the one hand, more impulsive behavior can result from oversensitivity to immediate rewards. On the other hand, more impulsive behavior can be the result of disregarding future outcomes. However, it is not yet well understood which of these processes contribute to adolescent increases in impulsiveness. To address this question, we (van den Bos et al., 2015) tested participants between 8 and 25 years of age. To distinguish between different developmental hypotheses, we investigated developmental changes in the structural *and* functional connectivity of different frontostriatal tracts (see Figure 18a), which form the connections between the core regions involved in decision making. Our results show that adolescents were more impulsive (see Figure 18b) and reported less future orientation (see Figure 18c) than young adults. Furthermore, developmental increases in structural connectivity strength between the striatum and right dorsolateral prefrontal cortex were related to increased functional top-down modulation of striatal activity. In turn, this was related to an age-related decrease in impulsivity (see Figure 18d). These results suggest that mainly increased control, not sensitivity to immediate rewards, drives age differences in delay discounting across adolescence.

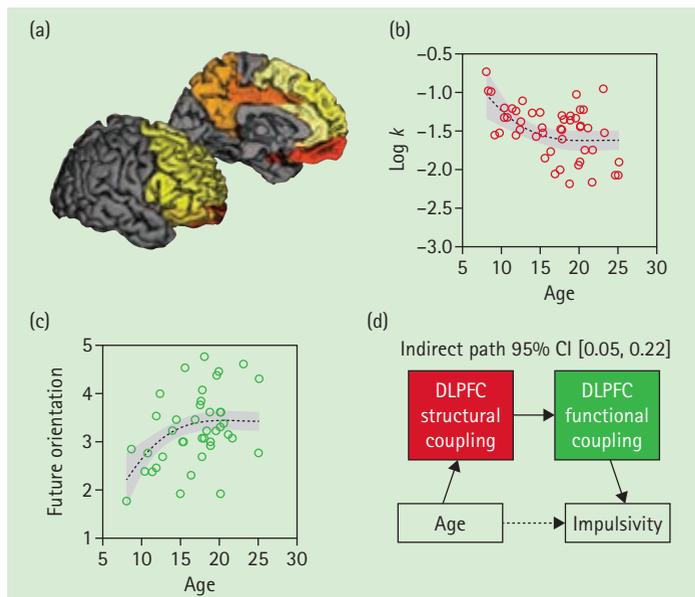


Figure 18. Adolescent impatience and frontostriatal connectivity. (a) Striatal segments and their color-coded corresponding cortical targets. Connection strength was based on probabilistic tracking of diffusion-weighted data. (b) Discount rates ( $k$ ) estimated from the delay-discounting task were smaller with age, and there was (c) an age-related increase in future orientation. (d) Process model linking age-related differences in brain structure, function, and behaviors showing significant mediation. CI = confidence interval; DLPFC = dorsolateral prefrontal cortex (adapted from van den Bos, Rodriguez, Schweitzer, & McClure, 2015).

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## Simple Memory-Based Judgments Across the Lifespan

From infancy to old age, humans make inferences and judgments in an inherently uncertain world. People can do so by relying on available cues that are only probabilistically related to some criterion in the environment. Recognition memory is a prime example of a particularly simple cue that can be strategically exploited for inference (Pachur, Todd, Gigerenzer, Schooler, & Goldstein, 2011). For example, if you do not know which of two cities, say, Heidelberg or Fürth, has a larger population, you can base your judgment on which of the two names you recognize. This *recognition heuristic* often leads to astonishingly good performance because familiar items differ systematically from unfamiliar items on relevant attributes. After all, we are more likely to have heard about larger cities, more successful sports teams, or more popular brands. Past research has focused on the strategic use of the recognition heuristic in younger adults; investigations of the use of the heuristic at earlier or later phases of the lifespan are rare.

We (Horn, Pachur, & Mata, 2015) aimed to fill this gap by investigating the adaptive use of the recognition heuristic across different age groups and task domains using cognitive modeling techniques that measure strategy use. Specifically, we presented participants with a domain (inferences about city population sizes) in which recognition is usually a valid cue (i.e., recognition is highly associated with the criterion) and another in which this is not the case (inferences about disease incidences). By using comparable materials across studies, we were able to study the potentially adaptive use of recognition across children, adolescents, and younger and older adults.

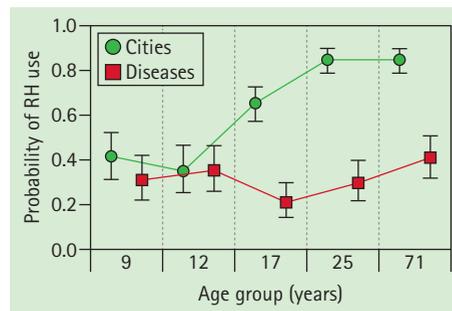


Figure 19. Average use of the recognition heuristic (RH) as a function of age group and task environment (adapted from Horn, Ruggeri, & Pachur, 2016).

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The findings suggest, first, that the validity of recognition is similar across age groups and that recognition is a relatively useful cue even for the younger age groups. This is in line with the notion that the core ingredient for implementing this simple strategy—the capacity for familiarity-based recognition—is robust and developed from an early age.

We (Horn, Ruggeri, & Pachur, 2016) also investigated the use of the recognition heuristic across five age groups. Even primary school children made systematic use of the recognition heuristic (see Figure 19). Furthermore, children's strategy use did not differ as a function of the validity of the cue, whereas older adolescents and adults (older and younger alike) adaptively adjusted their strategy use between domains and were also better able to discriminate between situations in which the recognition heuristic resulted in correct versus incorrect inferences. These findings suggest that the adaptive use of the recognition heuristic requires experience and a developed base of domain-specific knowledge and therefore increases with age.

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## Research Area 5: The Boosted Mind

In recent years, policymakers have shown mounting interest in using behavioral science to make government simpler, less expensive, and (especially) more effective. For instance, in 2015, President Barack Obama issued an Executive Order directing many federal agencies to use behavioral science to improve their policies. In the United Kingdom, a Behavioral Insights Team, in operation since 2010, has also enlisted behavioral science to promote change in a wide range of areas, including tax compliance and organ donation. In 2015, the World Bank devoted its entire annual report to the subject of behavioral science. To date, much of the discussion of behaviorally informed approaches has emphasized “nudges,” that is, interventions designed to steer people in a particular direction while preserving their freedom of choice. Yet, behavioral science also provides support for a distinct kind of nonfiscal and noncoercive intervention, namely, “boosts.” Their objective is to foster people’s competence to make their own choices—that is, to exercise their own agency. The Center has worked both conceptually and empirically on this class of policy interventions.

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*Figure 20.* Two approaches for harnessing behavioral insights and evidence for public policy: (a) Nudging (Thaler & Sunstein, 2008), that is, nonfiscal and nonregulatory interventions that steer people in a particular direction while aiming to preserve freedom of choice (e.g., automatic enrollment in pension plans). (b) Boosting (Grüne-Yanoff & Hertwig, 2016), that is, fostering people’s cognitive and self-control capacities to thus enable them to make their own choices (e.g., teaching statistical literacy, provision of simple decision tools).

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### Boosting: How to Help the Decision Maker Make Good Decisions

Many of the attempts to harness behavioral insights and evidence for public policy have emphasized “nudges,” that is, nonfiscal and

nonregulatory interventions that steer people in a particular direction while preserving freedom of choice. Automatic enrollment in a pension plan or in green energy, for example, counts as a nudge. Freedom of choice is preserved, so goes the idea, because the ultimate decision of whether to accept the automatic enrollment default and its consequences remains with the individual. Yet as we (Grüne-Yanoff & Hertwig, 2016) have emphasized, behavioral science also offers firm support for a distinct kind of public policy intervention, namely, “boosts” (see Figure 20). The objective of boosts is to foster people’s capacity to make their own choices. To this end, interventions can further an individual’s skills and knowledge, expand the available set of decision tools, or target the environment in which decisions are made. Examples are the transparent design of health statistics so that patients can decide for themselves whether the potential benefits of a recommended medical test outweigh its potential harms. Similarly, physicians’ choice architecture can be adapted to improve their diagnostic accuracy by harnessing collective intelligence (see subsection “The collective mind”). Individuals can also be equipped, for instance, with simple financial accounting rules or simple strategies that enable them to arrange, for example, a family meal environment in ways conducive to nutritional health. Because boosts aim to preserve agency or even enable individuals to exercise their own agency, they either avoid making assumptions about



people's preferences and goals or, if necessary, make those assumptions transparent. Nudge and boost policies rest on fundamentally different research programs on bounded rationality, namely, the *heuristic-and-biases* program and the *simple-heuristics* program (Gigerenzer, Hertwig, & Pachur, 2011), respectively. In an extensive analysis, we (Grüne-Yanoff & Hertwig, 2016) examined the policy-theory coherence of each of these approaches, identifying the necessary assumptions about the decision maker (e.g., awareness about his or her cognitive errors; the ability and motivation to control these errors) and about the policymaker (e.g., the policymaker's benevolence) underlying each policy and analyzing to what extent these assumptions are implied by the theoretical commitments of the respective research program. The results show that the two policy approaches not only rest on strongly diverging assumptions both also suffer from a degree of disconnect with the respective theoretical program, though to different extents. Specifically, the heuristics-and-biases program does not imply all the assumptions built into nudge policies, neither does the simple-heuristics program imply all assumptions built into boost policies. For instance, the heuristics-and-biases program is not committed to the assumptions that public designers of policies are less vulnerable to cognitive errors than citizens, a necessary assumption of the nudge approach. Similarly, the boost approach assumes a modicum of cognitive skills and motivation, but nothing in the simple-heuristics program explicitly refers to this issue. This partial disconnect between theory and policy appears to be more pronounced in the nudge than in the boost approach. Given the great interest in behavioral insights by public policymakers, one goal for the future is to further develop the conceptual and empirical foundations of the nudge and boost approaches and to clarify that behavioral science evidence can support many distinct kinds of nonfiscal and nonregulatory interventions. Of interest in this context, the recent OECD 2017 report "Cracking the behavioural insights' nut: Behavioural sciences and their applica-

tion to policy design and delivery" acknowledges boosting and the fact that behavioral evidence also supports policy interventions beyond nudging.

The boost and nudge approaches to public policymaking are neither completely interchangeable nor mutually exclusive. To shed light on the specific conditions under which one of the two approaches is more promising, we (Hertwig, in press-a) proposed rules that policymakers could apply to determine which is the preferable form of intervention in a given situation. This set of rules suggests, for instance, that boosts, which aim to give choosers agency, may have the advantage of avoiding unintended and hard-to-predict side effects. Boosts may also be the preferred intervention when the goal is to produce lasting and generalizable benefits, fitting better to a set of heterogeneous population preferences or very uncertain preferences. At the same time, arguments for boosts are weakest when individuals have low levels of competence or motivation and when effective boosts would be costly to implement.

In what follows, we report on the Center's research that can inform and support boost policy interventions in a wide range of domains, such as medical diagnostics, patient-physician communication, end-of-life surrogate decisions, and nutritional health, to name a few.

### Boosting Dietary Decision Making

Up to 60% of the population in Europe is overweight, making overweight one of the major health challenges of this century. People have been reported to make about 200 food decisions a day, and poor food choices contribute to weight gain. How can these decisions better promote health? Policymakers have a wide range of tools available to influence eating behavior, including bans (e.g., banning vending machines at schools), taxing unhealthy food (e.g., soda tax), or nudging people toward healthier choices (e.g., changing the presentation order of food items in a cafeteria). Another approach is boosting people's food-related decision-making competences. One principal advantage of the boosting approach is that people

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can use their acquired skills across a wider range of settings, including those that are hard to reach by nudges, such as the home environment.

The home environment often provides a core social context for eating—and this is particularly true for children. Parents are their nutritional gatekeepers: They prepare and control the family's food and model eating behavior (Wansink, 2006). To understand the influence of parents on their children's body weight, we (Dallacker, Hertwig, Peters, & Mata, 2016) interviewed 320 parent-child dyads to investigate the association between parental numeracy and children's body mass index (BMI). Numerical abilities are central for several weight management behaviors, including the comprehension of nutrition labels. The results showed that lower parental numeracy was associated with both over- and underweight in children, whereas higher numeracy was associated with normal weight. Parental numeracy may thus be an important target when developing interventions to boost healthy eating behavior in children.

Preventing overweight is far more effective than treating it. To effectively boost individuals, it is also important to understand when people are particularly vulnerable and would benefit most from a boosting intervention. In a representative survey across nine European countries, we (Mata, Frank, & Hertwig, 2015) compared the body weight of individuals who were single with those who were married. We found that across all countries, being married was consistently associated with a higher BMI. This finding suggests that major life transitions can result in significant weight changes. More generally, events such as moving in with a partner, marriage, having children, and even divorce may thus lead to significant weight gain. We currently address the possibility of critical time windows for when to boost healthy food choice with the help of an ongoing longitudinal study.

### Boosting Health-Care Professionals' Risk Communication

Ultraviolet (UV) radiation exposure from the sun and artificial UV sources is widely acknowledged to be the major culprit for skin cancer and premature skin aging. The sun pro-

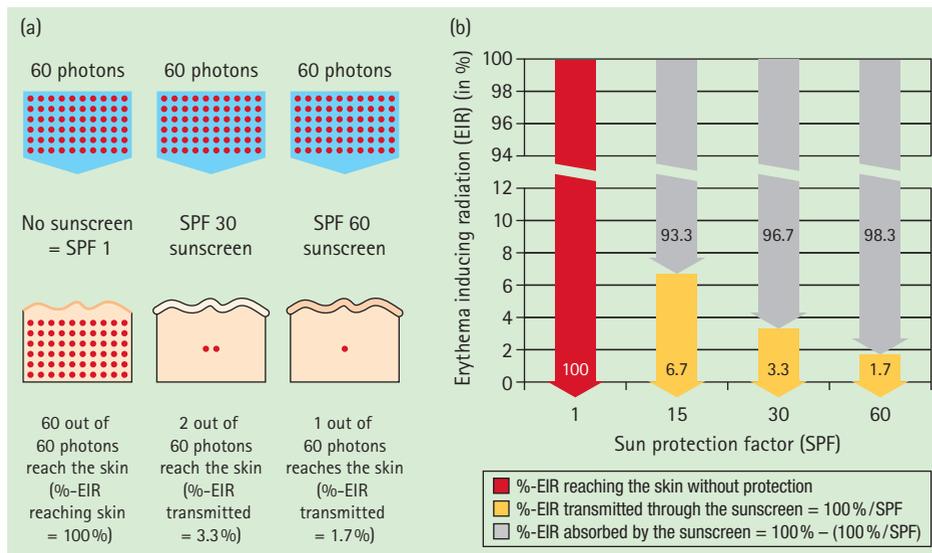
tection factor (SPF) is the sunscreen parameter most widely known by both laypeople and health-care professionals. The SPF conveys a sunscreen's effectiveness in protecting against the UV radiation that causes sunburn (i.e., erythema-inducing radiation, EIR) and is defined as the ratio of the EIR dose that induces the first perceptible erythema on sunscreen-protected skin to the EIR dose that induces the same erythema on unprotected skin. Importantly, the EIR burden for skin depends on the proportion of EIR actually transmitted through the sunscreen to the skin (%-EIR transmitted). Doubling SPF from, say, 30 to 60 halves the %-EIR transmitted from 3.3% to 1.7%, thus doubling protection (see Figure 21).

Despite the high level of awareness among both consumers and professionals, in recent years, erroneous explanations about the meaning and implications of the SPF have been propagated by public media, consumer protection groups, and even academic outlets (including *New York Times*, *Wall Street Journal*, NBC News, *Consumer Reports*, Environmental Protection Agency, and American Academy of Dermatology). More specifically, media and health professionals have, unfortunately, focused on a different, irrelevant statistic, the proportion of EIR absorbed by the sunscreen (%-EIR absorbed =  $1 - \%$ -EIR transmitted). They have noted that the increase in %-EIR absorbed by the sunscreen is much less pronounced than the corresponding increase in SPF values. For example, the increase of %-EIR absorbed from 96.7% to 98.3% is argued to be much less pronounced than the corresponding increase in SPF from 30 to 60. However, as illustrated in Figure 21, only changes in %-EIR transmitted directly relate to changes in SPF and thus, ultimately, to changes in EIR burden; changes in %-EIR absorbed are not directly related, and the fact that the numerical changes appear small is irrelevant.

To test whether even dermatology experts are misled by framing a sunscreen's effectiveness as %-EIR absorbed, we (Herzog et al., 2017) recruited 261 dermatology experts from Germany, Switzerland, the United States, and Australia for a randomized Web experiment.

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**Figure 21.** Erythema-inducing radiation and sun protection. (a) Proportion of erythema-inducing radiation (EIR; illustrated with 60 photons) reaching the skin with no protection (sun protection factor, SPF = 1) and transmitted through the sunscreen to the skin for SPF 30 and 60. For further illustration, see the online video at <http://bit.ly/SPF10-50>. (b) The %-EIR reaching the skin without protection (red), %-EIR transmitted through the sunscreen (yellow), and %-EIR absorbed by the sunscreen (gray) for SPF 1, 15, 30, and 60. The %-EIR transmitted is directly related to SPF: As SPF doubles, %-EIR transmitted is halved (adapted from Herzog et al., 2017).

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Experts assessed the increase in protection for 10 pairs of sunscreens with different SPFs (i.e., all 10 pairwise combinations of SPF values 10, 15, 20, 30, and 50) using either SPF, %-EIR absorbed, or %-EIR transmitted. When sunscreen effectiveness was presented as %-EIR absorbed, dermatology experts strongly underestimated the increase in protection provided by a stronger sunscreen. Assessments based on %-EIR transmitted and, in particular, SPF were more accurate. Therefore, for effective communication of sunscreen effectiveness among health-care professionals, patients, and consumers, we recommend that SPF be used exclusively and that presentations based on the %-EIR absorbed or transmitted be avoided. Especially in light of the worldwide increasing incidence of skin malignancies related to UV radiation, the clarification and prevention of this misunderstanding is urgently needed. To curb the skin cancer epidemic, health-care professionals should have no doubts about the basics of the SPF and should consistently advise people to use high to very high SPF sunscreens that

include adequate UVA protection along with other sun-protective measures, such as seeking shade and wearing protective clothing.

### Boosting Doctors' and Patients' Communication in the Emergency Department

The efficient communication between physician and patient is a pillar of good health care. By extension, ineffective communication is likely to adversely affect patients' satisfaction, trust, willingness to cooperate, and health status. A number of studies have shown that patients, on average, forget roughly half of the information they get in medical consultations. This is likely to be even worse in high-stakes medical environments, such as emergency departments (EDs), and condition, such as time pressure, constant interruptions, lack of privacy, and patient's pain and anxieties. At the same time, discharge from the ED is a period of high vulnerability for patients. They might run the risk of further clinical deterioration, suffer from a misdiagnosis if the diagnostic

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process was not exhaustive, or experience side effects from newly prescribed drugs. Compounding these risks, deficits in communication and information transfer at hospital discharge are common and may adversely affect patient care.

One little-explored approach to dealing with these difficult problems is to boost doctors' skill in communicating discharge information, which by extension would boost patients' recall of the vital content. We, in collaboration with the ED of the University Hospital of Basel, Switzerland, have advanced a research program with the following three goals: first, to define the ideal content of ED discharge communication; on the basis of this ideal content, second, to devise and test a memory aid that simultaneously helps doctors structure their communication and boost patients' recall; and third, to examine the long-term effects of improved discharge communication on actual patients' health outcomes. Regarding the first goal, we (Ackermann, Heierle et al., 2016), probed ED doctors and ED patients' informational preferences and focused on information on chest pain. We found that, fortunately, the two parties' informational preferences largely overlapped. On the basis of this convergence, we defined the ideal content of the discharge communication by categorizing the expressed need for information into five key categories: (1) information on diagnosis; (2) follow-up suggestions; (3) advice on self-care; (4) red flags; (5) complete treatment.

Regarding the second goal, we (Langewitz et al., 2015) developed a structure ED doctors can use to communicate based on these five categories and we used clear transitional remarks between the five blocks of information. Hypothetical patients in the group in which this structure was provided remembered significantly more items of the discharge information. Furthermore, the recall of patients with the lowest levels of medical knowledge showed the strongest improvement from information structuring. Regarding the third goal, we are now in the process of evaluating the long-term effects of information structure in the presentation of discharge information on real patients' health outcomes

in the context of actual interactions between patients and doctors in the ED.

## Boosting Medical Diagnostics

Despite the enormous importance of preventable medical errors, research on effective strategies to decrease diagnostic errors is still relatively limited. We therefore conducted a number of experimental and simulation studies to identify conditions and circumstances that can boost doctors' diagnostic competences, reduce diagnostic errors, and enhance patient safety (see also subsection "The collective mind").

In an experimental study, we (Hautz, Kämmer, Schaub, Spies, & Gaissmaier, 2015) investigated the extent to which direct collaboration between two junior physicians enhances diagnostic accuracy in the ED, a complex decision environment where many initial diagnoses are made and diagnostic errors are rife. In a high-fidelity computer experiment, participants faced six simulated patients arriving at the ED with dyspnea (shortness of breath). Cases progressed from an initial video presentation of a patient actor through a phase of diagnostic tests to the decision on a final diagnosis. Type, number, and order of diagnostic tests were chosen by participants and resulted in the presentation of real clinical data (e.g., X-ray or lung sounds), which had to be interpreted. Participants worked either alone or in pairs. We found that working in pairs reduced the rate of diagnostic errors by 17 percentage points without increasing diagnostic effort. The collective benefits seem to have arisen from teams' enhanced information processing and error correction. In addition, our results point to another "tool" for getting the most out of teamwork: asking teams to reflect on and compare their confidence in their decisions. We found that the joint decisions most likely to be wrong were those where the two diagnosticians differed most in their individual decision confidence.

Working in teams is one way to boost diagnostic accuracy. But there are other ways of empowering doctors, especially when time is crucial as is often the case in the ED. The very first moment of the patient-doctor

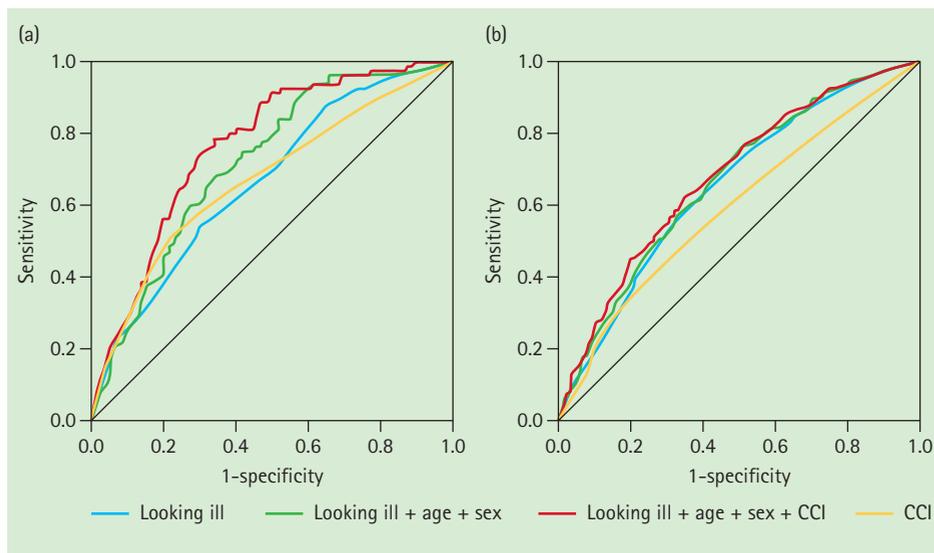


Figure 22. Predicting mortality and morbidity using emergency department doctors' clinical impression of how ill a patient with nonspecific symptoms looks. The performance of two single variables (looking ill and CCI) and two sets of predictors (looking ill, age, and male sex, with or without CCI) in the ROC space for the outcome variables (a) mortality and (b) acute morbidity (adapted from Beglinger et al., 2015). CCI = Charlson Comorbidity Index; ROC = receiver operating characteristic.

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interaction occurs when the patient enters the ED. Can this moment be harnessed in the service of the *initial* diagnostic assessment of a patient? For instance, does readily available information—a patient looking ill, age, or sex—have value for predicting clinical outcomes in patients? If so, this could help emergency physicians decide whether to perform further diagnostic tests or hospitalize the patient. To find out, we (Beglinger et al., 2015) conducted a prospective observational study with a 30-day follow-up. This was performed at the ED of the University Hospital of Basel and included a patient group with nonspecific complaints who presented to the ED. At the outset of the physician–patient interaction and before history taking, the physician evaluated the patient’s overall clinical condition by answering the following question on a numerical scale ranging from 0 to 100: “How ill does this patient look?” In total, 110 physicians gave their first clinical

impression for 1,240 patients. How well does this initial clinical impression, in combination with other easily available cues (age and sex), predict patients' mortality as well as acute morbidity? Figure 22 shows the results in terms of the receiver operating characteristic curve. The variable “looking ill” was clearly associated with the ED patients' mortality and morbidity. The combination of the variables “looking ill,” age, male sex, and the score on the Charlson Comorbidity Index (an easily determined measure used as a predictor of mortality) resulted in the best prediction of these outcomes. Taken together, these results suggest that the clinical impression of how ill a patient looks is an extremely low-cost and immediately available piece of information that doctors can use to swiftly decide on a course of action. Our findings may help empower ED doctors to enlist this “informal” information that doctors are likely to have used in the past with a guilty conscience.

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(last update: Spring 2017)

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# Center for the History of Emotions

Director: *Ute Frevert*



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Sensation is crucial ...  
Kazimir Malevich, *The World as Non-Objectivity*  
(First Edition Munich, 1927, p. 65)

Sensations and emotions, as the Russian artist Kazimir Malevich acknowledged, are crucial in a variety of ways: They are as crucial for the painter in guiding his brush as they are for the viewer in making sense of and appreciating a work of art. But they are also crucial in a wider sense, as Malevich's *Three Female Figures* suggests. The women's faces are blank and lack any sign of emotion. They resemble hollow shapes that need to be filled in in order to be rendered human.



K. Malevich (ca. 1930). *Three Female Figures*.

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## Introductory Overview

While the Center's focus on studying the history of emotions was one of a kind in 2008, recent years have seen the growth of related research on a global scale. This testifies to the overall relevance of the new field. At the same time, it allows for increased cooperation and collaboration in which the Center takes a leading role. Its work is recognized internationally by historians as well as by scholars and scientists from other disciplines. When the General Assembly of the International Committee of Historical Sciences chose "Emotions" as one of four major themes at the World Congress of 2015 and invited Ute Frevert (together with Philippa Maddern from Australia) to organize the day-long panel, they acknowledged both the general interest in emotions as a topic of historical inquiry and the salience of the Center's research. At the same time, the editors of the *Handbook of Emotions* asked Ute Frevert to write an article on "The History of Emotions," which they considered, to quote Lisa Feldman Barrett, to be "one of the most important contributions to the volume." This indicates that the science of emotions (dominated by psychologists and neuroscientists) has come to place more weight on history, a fact also shown in the conferences and publications of the International Society for Research on Emotion.

The Center for the History of Emotions (HoE) makes its work accessible through public seminars and lectures, conferences, and publications.

In December 2016, Pascal Eitler and Uffa Jensen organized the international conference *Failing at Feelings*. It sought to counteract the common assumption that emotions always work as they should. While people often expect or desire to experience a particular emotion in a particular situation, such emotions sometimes do not appear or last long. This can be observed in relation to family and gender, sexuality and seduction, politics and protest, as well as to animals and things. The conference inquired into the concrete historical and social circumstances that condition this failure to feel. Against this background, participants also discussed the successful production of emotions, the role of institutions, discursive frames, competing norms, significant others, and divergent expectations, as well as the importance of conflicts and situational factors. The failure to feel tells us something about the possibilities of successful feeling and about the historicity of emotions.

A selection of papers will be published in a peer-reviewed journal.



## Key Reference

**Frevert, U.** (2016c). The history of emotions. In L. Feldman Barrett, M. Lewis, & J. M. Haviland-Jones (Eds.), *Handbook of emotions* (4th ed., pp. 49–65). New York: Guilford Press.

Among the Center's publications, the book series "Emotions in History" features prominently.

### Emotions in History—A Book Series With OUP

The series, jointly edited by Ute Frevert and Thomas Dixon (Queen Mary University, London), takes various perspectives on emotions by drawing on the history of science, medicine, psychology, literature, art, religion, politics, and economics. Contributions range from medieval to modern periods and reach across regional and national boundaries. The series was launched in February 2014 and its fifth volume was released in 2016. Four out of five volumes originated at the Center; three more will be added in 2017.

- Ute Frevert et al., *Emotional Lexicons: Continuity and Change in the Vocabulary of Feeling 1700–2000*
- Jan Plamper, *The History of Emotions: An Introduction*
- Ute Frevert et al., *Learning How to Feel: Children's Literature and Emotional Socialization, 1870–1970*
- Margrit Pernau et al., *Civilizing Emotions: Concepts in Nineteenth Century Asia and Europe*
- Erin Sullivan, *Beyond Melancholy: Sadness and Selfhood in Renaissance England*



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Two of these volumes (*Emotional Lexicons*; *Learning How to Feel*) have come out of collaborative projects at the Center. Carried out over multiple years and bringing together 10 to 20 researchers, these long-term projects go far beyond what can be achieved at conferences and in conference publications. Each begins with a set of common research questions that are then broken down into individual chapters. Multiple rounds of debate and criticism serve to produce a coherent, yet multifaceted perspective. The process of producing the final book manuscript takes between 2 to 3 years of intense collaboration. Only institutions like the Center can effectively foster such collaboration. The work has received highly positive reviews from the research community.

At the end of 2014, we chose emotional encounters as the topic of our next collaborative project. Capitalizing on our strong interest in transnational history, the project examines face-to-face encounters across cultural boundaries over a long-term perspective. It addresses the emotions people have experienced in cross-cultural encounters by drawing on individual case studies. Collaborating researchers inquired into the strategies people have employed to interpret one another's emotions as well as the role emo-

tions have historically played in facilitating or obstructing communication across cultural divides. Starting from contemporary experience, *Encounters With Emotions* sets out to highlight historical changes and transcultural dynamics in how emotions have been used to negotiate cultural differences. The manuscript has been submitted to OUP and is currently under review.

Alongside long-term collaborative and individual projects, scholars at the Center also set up three different reading groups between 2014 and 2016 that focus on the multisensory, law, and economy. Another reading group on religion was launched in December 2016. In regular meetings, group members discuss precirculated articles or book chapters. The reading groups have been well received not only at the Center but have also attracted members of the MPRG Felt Communities, graduate students from the IMPRS Moral Economies, and students from Berlin universities.

In 2014, the Center recruited several international researchers with an interest and expertise in law and its relation to emotions. Their research spans from the early modern period to the 20th century, thus extending beyond the original focus on modernity. This has allowed them to explore continuities

and discontinuities in discourses on reason and rationality, on good and bad morals, "cool" and "hot" blood, and on emotions that were deemed just or unjust, acceptable or despicable.

A new focus group on "Religious Feeling—Feeling Religious" was recently established, following in the footsteps of the Center's previous research on religious enthusiasm, the "New Age" movement, and on religious charity and social work. A workshop in June 2016 served as a platform for discussing major epistemological questions and hypotheses with international scholars and members of the Australian Research Council Centre for Excellence in the History of Emotions (ARC CHE). In September 2016, three new research projects were added to the Center:

- Stephen Cummins, *Penitent Feelings: Confession and the Emotions in Catholic Europe, c. 1600–1800*;
- Carlos Zúñiga Nieto, *Carmelite and Ursuline Nuns' Religious Feelings of Trust and Love in the Making and Unmaking of the Spanish Empire, 1850–1914*;
- Makoto Harris Takao, *Countering Christianity: Religious Phobia and the Making of Modern Japan, 1823–1912*.

Other researchers at the Center have also taken a keen interest in religion, as have graduate students of the IMPRS Moral Economies, and will join the focus group in numerous pursuits. More postdoctoral fellows will follow in 2017, thus expanding the temporal and regional scope.

The 51st Historikertag in 2016 with the theme *Matters of Belief* revolved around the significance of religion in contemporary society and history. Because India was the 2016 partner country, the Center presented its research on South Asia in a series of posters, publications, and talks. Imke Rajamani gave a talk on *Religions in Indian Communities and Societies* and Margrit Pernau a talk on the *Global History of Religions*.

The German "**Historikertag**" is a biennial conference that presents and discusses current historiographical research. It draws up to 4,000 visitors (scholars, history teachers, high-school and university students, journalists), making it one of the largest humanities conferences in Europe.

For the 50th Historikertag in 2014, the Center was invited to organize a well-visited panel on *Feeling History: What Can We Gain or Lose by Researching Emotions?* Apart from Ute Frevert and Benno Gammerl, Frank Bösch (Potsdam), Valentin Groebner (Luzern), Lyndal Roper (Oxford), and Dorothee Wierling (Hamburg) addressed questions like:

- How can feelings be theoretically defined and empirically grasped in a historically meaningful, methodologically rigorous way?
- Is the history of emotions interested in searching for a clear, universal reality grounded in neuroscience beyond the confines of the linguistic turn and poststructuralism?
- Does historical research on emotions provide fresh, valuable perspectives on the history of bodies and subjectivities in particular and on cultural, economic, and political dynamics in general?
- Does the history of emotions run the risk of getting caught up with insignificant micro-social phenomena, thus losing sight of pressingly relevant phenomena like social inequality and power struggles?

The lively discussion demonstrated participants' interest in the field. The panel clearly reached its goal of firmly placing the "History of Emotions" on the agenda of German historiography, which, compared to the international community of historians, has taken much longer to acknowledge and embrace it. The high international impact of the new field can best be judged by its prominence at the 2015 *World Congress of Historians* in Jinan (China). The Congress, which takes place every five years, hosted 2,700 participants from 90 different countries. Apart from 60 smaller panels, 4 major topics were selected for day-long panels, one of them being Historicizing Emotions. Ute Frevert (who had initially planned the theme day together with the late Philippa Maddern, founding director of the

#### Key Reference

Eitler, P., Hitzer, B., & Scheer, M. (Eds.). (2014a). Feeling and faith: Religious emotions in German history [Special issue]. *German History*, 32(3).



Poster for the 51st Historikertag.

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## Key Reference

Frevert, U. (2016b). Historicizing emotions (CISH Major Theme Day 2) [in Chinese]. *World History*, 235, 16–23.

[www.mpib-berlin.mpg.de/en/research/history-of-emotions/world-congress-of-historians-jinan-2015](http://www.mpib-berlin.mpg.de/en/research/history-of-emotions/world-congress-of-historians-jinan-2015)



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ARC CHE) chaired and introduced the topic to an audience of about 800 people. Eleven researchers—among them Anne Schmidt and Benno Gammerl—from eight countries presented their work in four panels (*Emotions, Capitalism, and the Market; Emotions and the Creation of "Others"; Emotions in Bodies and Spaces; Historicizing Emotions: Theories and Methodologies*).

Apart from widening the geographical and chronological scope of the Center's research, the group's researchers have discussed future orientations and research agendas. Starting in 2008, research at the Center has been organized in three central areas: cultivation and education, embodiment, and power relations. The areas serve to both structure and integrate the large number of individual projects. In the future, we plan to introduce a new area (potentially replacing "embodiment") that will highlight the importance of emotion knowledge and science. In addition, we have formed so-called focus groups for researchers interested in topics like law and religion. Along with these, the following projects aim to supplement our portfolio, especially in the field of education:

- The project *From Intelligence Measurement to Emotional Competence: The Classroom as a Laboratory of Modernity* (Anja Laukötter)

will study the history of the classroom from the early 20th century to the present. It seeks to demonstrate that foundational elements of the laboratory as a space of experimentation (whose origins can be traced back to the late 18th and early 19th century) eventually found their way into other social spaces during the 20th century. Empirical and educational psychology thus treated the classroom as an object of research. Using methods from the history of science, the project aims to better understand the status of emotions and their relation to cognition in psychological models and methods. It will investigate the ways in which psychology has come to shape ideas about "development" and, more generally, the habitus of everyday life.

- The project *New Education* (Margrit Pernau) takes as its starting point debates on the civilizing process and criticisms of the concept. Since the late 19th century, both have contributed to the development of new forms of education geared toward creating new men and women with new emotions. The project's primary case study focuses on the Jamia Millia Islamia in Delhi, which provides education mainly for Muslims from kindergarten to the university. Founded after World War I as a project

## New Regions on the World Map of the History of Emotions

Initially, research at the Center concentrated on the modern period (18th to 20th centuries). Geographically, it focused on Europe, North America, and South Asia. Between 2014 and 2016, research expanded both chronologically to the early modern period and geographically to Latin America, Japan, and Turkey (Ottoman Empire).

At the same time, there is a growing interest in the field beyond Europe, the United States, and India. At Jinan, for example, participants of the panel *Historicizing Emotions* initiated a research network in Latin America. In 2016, Ute Frevert followed the invitation of Andrea Noble (University of Durham, UK) and Zandra Pedraza (Universidad de los Andes, Colombia) to introduce Colombian students to research on the history of emotions and meet interested colleagues. The cooperation will be continued.



Figure 1. Exploring new world regions on the world map of the history of emotions.

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of the Indian national movement, Jamia's political concept was strongly influenced by interaction with German Reformpädagogik between the 1920s to the 1970s, particularly its ideas about work as a way to form students' minds, hearts and bodies.

Since its very launch, the Center has established strong ties to international colleagues working in related areas. This includes the Centre for the History of the Emotions at Queen Mary University (London), launched in November 2008 and led by Thomas Dixon (co-editor of the OUP series *Emotions in History*). It also extends to the ARC CHE, which has its headquarters at the University of Western Australia.

Taking advantage of Laura Kounine's early career fellowship at the University of Melbourne, two international conferences were jointly organized in 2015–2016 on *Witchcraft and Emotions*. The first took place in Melbourne and focused on *Media and Cultural Meanings*. It brought together scholars from disciplines such as history, art history, and anthropology to explore the emotional self-representation of accused witches and their accusers. The second conference, hosted at the Institute, concentrated on *Social Conflict and the Judicial Process*, taking into special consideration the Center's strong interest in the interplay between law and emotions. Using witch trials as a prime example of emotional jurisdiction, historians, anthropologists, and scholars of religion outlined the ways in which accusers and witnesses vented their hatred and fear and how this impacted the outcome of the trials.

The Society for the History of Emotions, a global professional association for historians of emotions recently established by the ARC CHE, nominated Ute Frevert as one of ten council members. Margrit Pernau has been invited to join the editorial board of the Society's peer-reviewed interdisciplinary journal *Emotions: History, Culture, Society*, whose first issue will be published in 2017.

The collaboration with the Centre de l'Inde et de l'Asie du Sud at the EHESS (Paris) on *Emotions and Political Mobilization in South Asia* has been successfully brought to a conclusion. Margrit Pernau and Imke Rajamani were part



Figure 2. Education at the Jamia aimed at bringing together intellectual training and manual labor.

Source: M. Hasan and R. Jilil, *Partners in Freedom: Jamia Millia Islamia, New Delhi* 2008, p. 103.

of a research team comprising scholars from different disciplines (political science, sociology, anthropology, psychology, history, and literature) who worked on mass movements in Pakistan, India, and Bangladesh from the 19th century to the present.

The research group *The Healthy Self As Body Capital: Individuals, Market-Based Societies and Body Politics in Visual 20th-Century Europe* is funded by the European Research Council and was established in October 2016. Led by Christian Bonah (Université de Strasbourg) and Anja Laukötter, it aims to better understand the role played by visual (mass) media and their emotional effects in the transition from the early 20th century's dominant national, biopolitical public health paradigm to the market-driven healthcare of the late 20th century. Main fields of research include the history of food and nutrition, of movement and sport, of sexuality and reproduction, and of addiction.

#### Public Colloquia and Visiting Scholars

Organized weekly or fortnightly during the academic year and open to the public, the Center's colloquium has become an established institution among university students, doctoral candidates, and researchers from the Berlin area and beyond. Since the first seminar in April 2008, more than 140 public colloquia have taken place with speakers from all over the world. Out of the 49 colleagues who presented their work in the reporting period 2014–2016 (see Appendix pp. 307–315), 40%

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**Kounine, L.,** & Ostling, M. (Eds.) (2016). *Emotions in the history of witchcraft*. Basingstoke: Palgrave Macmillan.

**Pernau, M.** (in press). Anger, hurt and enthusiasm: Mobilizing for violence in India, 1870–1920. In A. Blom & S. Tama Lama-Rewal (Eds.), *Emotions and political mobilization in South Asia*. London: Routledge.

**Rajamani, I.** (in press). Mobilizing anger in Andhra Pradesh: The emotional politics of the Angry Young Man and popular Telugu cinema. In A. Blom & S. Tama Lama-Rewal (Eds.), *Emotions and political mobilization in South Asia*. London: Routledge.

## Feelings Against Jews: The Emotional History of Antisemitism

Adverse feelings are a central part of antisemitism. However, the existing literature in the social sciences, social psychology, and history mainly emphasizes the cognitive aspects of antisemitism. As early as 1946, however, Jean-Paul Sartre defined antisemitism as a passion in his seminal work *Anti-Semite and Jew*. Following this perspective, Uffa Jensen's new project stresses the importance of emotions in the history of antisemitism, using insights from historical, sociological, philosophical, psychological, and neurological research. In 2016, the German Research Foundation (DFG) accepted Jensen's application for a Heisenberg Professorship, which will be affiliated with the Center for Research on Antisemitism at the Technische Universität Berlin.



were from the USA, 30% from Germany, 20% from Europe, and 10% from other countries. By invitation, national and international colleagues thus forge a comprehensive network of personal and institutional cooperation and scientific communication. This network reaches far beyond the historical discipline and includes scholars from sociology, political science, anthropology, evolutionary biology, economy, philosophy, literature, religion, music, and film studies. The Center has also kept close ties with former researchers (Monique Scheer, Jan Plamper, Dagmar Ellerbrock, Philipp Nielsen,

among others) who have been appointed as university professors and have used their status to foster cooperation on multiple levels (teaching, conferences, research). The Center has been attracting high-profile scholars from all over the world who choose to spend their sabbatical here (e.g., Laura Otis, Emory University, Atlanta; Barbara Jean Keys, The University of Melbourne) or are funded by institutions like the DAAD, national research foundations, etc. (see Appendix pp. 319–320). This has proven a welcome opportunity to engage in intense collaboration and expand the Center's visibility and academic outreach.



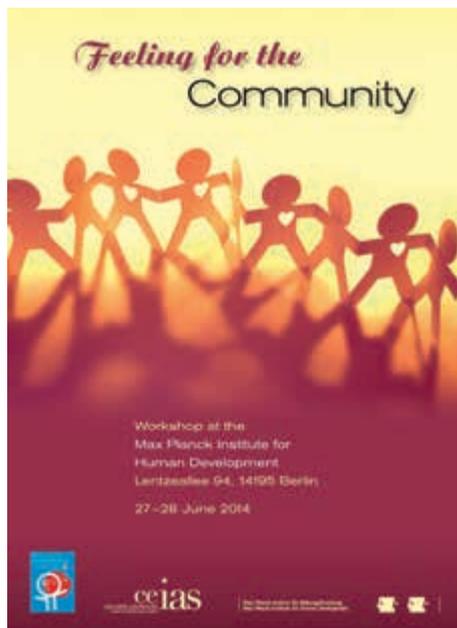
Since its launch in 2013, the bilingual internet portal *History of Emotions—Insights into Research* has grown considerably. The more than 20 contributions posted thus far have shown how the history of emotions can be fruitfully researched through in-depth analysis of a single source, such as a text, photograph, postcard, or film. They have thus drawn attention to broader questions and methods of the history of emotions. The internet portal is open to the Center's researchers and international scholars. Edited by Margrit Pernau, Anja Laukötter, and Laura Kounine, the short pieces are also available on social media, have received attention from the press and a broad audience, and are successfully used in academic teaching and research.

## Research Area: Education and Cultivation of Emotions

The history of emotions has sought to overcome the classical, but increasingly unproductive nature versus nurture dichotomy. Research on education and the way that actors learn to feel and make sense of their feelings must focus on norms and institutions. However, the latter cannot be adequately understood without studying the role of bodies and materializations, while, at the same time, bodies cannot be conceptualized outside their socialization.

### Collaborative Research Activities (selected)

In collaboration with the research project EMOPOLIS (*Emotions and Political Mobilization in South Asia*, EHESS Paris), the group organized an international workshop on *Feeling for the Community* in June 2014. Emotional communities are by now a well-researched topic. The group contributed by adding a temporal dimension to the concept of community, analyzing interactions between imagined communities based on a long-term perspective, like the nation or the religious community, and those that actually bring together bodies in space, and hence are much shorter in duration, like audiences, demonstrations, and riots. This research required the collaborative effort of scholars working with texts (journals, newspapers, novels), media experts (films), literary scholars focusing on performance studies (oral genres like poetry and sermons), and political scientists and anthropologists (personal interviews).



Several articles that came out of this workshop have been accepted for publication as a special issue of a prestigious journal.

The edited volume on *Childhood, Youth and Emotions in Modern History: National, Colonial and Global Perspectives* originated in a 3-day international conference on *Childhood, Youth and Emotions in Modern History* held at the Center in 2012. The organizers Stephanie Olsen and Juliane Brauer received over 200 applications, mostly from historians of childhood and education, many of whom have developed a strong interest in the history of emotions. *Childhood, Youth and Emotions in Modern History* demonstrates how scholars can write a history of childhood emotions and explains why combining the history of childhood and the history of emotions affords historians a more valuable, complex approach. The volume conceptualizes the tensions inherent to emotional formation on the "emotional frontier," a site where children's agency is subjected to competing emotional prescriptions, practices, and performances. The chapters represent the best new scholarship on the interplay of childhood and emotions as they relate to sexuality, war and conflict, politics and policy, space and material culture, youth organizations and institutions, and relationships with families, authority figures and peer groups. The 11 case studies cover a wide range of cultures and periods, spanning from Africa and Asia to Oceania and the Americas. The volume has received excellent reviews and feedback, underscoring the importance of the methodological and theoretical framework of the individual case studies, and is already widely used as a textbook.

## Researchers

Margrit Pernau  
Juliane Brauer  
Edgar Cabanas  
Benno Gammerl  
Uffa Jensen  
Kedar A. Kulkarni  
Anja Laukötter  
Stephanie Olsen

## Key References

Olsen, S. (Ed.). (2015a). *Childhood, youth and emotions in modern history: National, colonial and global perspectives*. Basingstoke: Palgrave Macmillan.



Pernau, M. (Ed.). (2017a). Feeling communities [Special issue]. *Indian Economic and Social History Review*, 54(1).

## Researcher

Benno Gammerl

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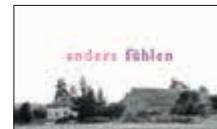
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**Gammerl, B.** (2015b). Ist frei sein normal? Männliche Homosexualitäten seit den 1960er Jahren zwischen Emanzipation und Normalisierung. In P.-P. Bänziger, M. Beljan, F. X. Eder, & P. Eitler (Eds.), *Sexuelle Revolution? Zur Geschichte der Sexualität im deutschsprachigen Raum seit den 1960er Jahren (1800|2000 Kulturgeschichten der Moderne No. 9)* (pp. 223–243). Bielefeld: transcript.

## anders fühlen—feeling differently

How did the normalization of homosexualities impact the emotional practices of men-loving men and women-loving women between the 1960s and the 1980s? How did the latter in turn affect processes of liberalization in West Germany? These are the core questions of the project. Firstly, it focuses on feelings that transgress societal norms. This aspect is highlighted in an issue on *Feeling Differently*, coedited for *Emotion, Space and Society*. Secondly, the study argues that such queerulent affects can trigger historical change. In this sense, the equality-based pattern of love that gained currency among gays and lesbians after the 1970s paved the way for the legal recognition of same-sex partnerships which was ultimately achieved in 2001. This link is explored in "Affecting Legal Change," which will be published soon. The interplay between emotions and spaces was explored in a co-edited themed issue for *sub\urban* (2015). The notion that spaces impact emotional patterns and vice versa, informs the structure of a monograph, which is currently being prepared for publication. It follows the shifts that the emotional lives of men-loving men and women-loving women have undergone since the 1960s in three roughly chronological sections entitled "avoiding," "getting on," and "arriving." Each starts with a chapter that traces major developments within the history of homosexualities, continues with a chapter about the spatial constellations—local, trans-

national, and urban/rural—within which agents experienced and made sense of their feelings, and concludes with a chapter on decisive changes in emotional patterns and practices. From this history of emotions perspective, the book criticizes the heroic narrative of liberation and the corresponding contentions that gay shame was transfigured into gay pride and that queer fears were ultimately overcome. Based on oral history interviews and gay and lesbian publications, the work shows instead that fear continued to shape the emotional lives of gays and lesbians. They did not rid themselves of anxiety, but rather learned to perceive and to handle it in new ways. This transpires from the filmic fear scripts that inform a 1982 article about a neo-Nazi attack on a gay journal's editorial office as well as a biographical narrative about a male assault on a female narrator. Analysis of both records supports the claim that emancipatory self-perceptions necessitated regular occurrences or productions of fear, which, in turn, enabled the emancipated subject to overcome this fear time and again. It is exactly such intricacies and decisive reinterpretations that lend a history of emotions perspective on the history of homosexualities its specific surplus value.



Logo of the project "anders fühlen"—"feeling differently."

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## Researcher

Uffa Jensen

### Key Reference

**Jensen, U.** (2014a). Across different cultures? Emotions in science during the early twentieth century. In F. Biess & D. M. Gross (Eds.), *Science and emotions after 1945: A transatlantic perspective* (pp. 263–277). Chicago: University of Chicago Press.

## Curing Emotions:

### A Transnational History of Psychoanalysis in Berlin, London, and Calcutta (1910–1940)

This completed project studied the transnational history of psychoanalysis in the early 20th century, focusing on Berlin, London, and Calcutta. The project understood psychoanalysis not just as a body of theories about the self but as a therapeutic practice that aims to influence the self. At the same time, the project stressed the emotional significance of psychoanalysis. The first part of the study looked at the institutional history of psychoanalysis in the three cities. It described how psychoanalysis was established both as a discipline outside of university structures and as a therapeutic technique

on an expanding market of psychotherapeutic cures. Major figures were identified, as were the core institutions of the psychoanalytic movement on a local level: private practices, clinics, training institutes, etc. This section also discussed institutions that facilitated the globalization of psychoanalysis, such as congresses, publishing houses, journals, etc. The second part of the manuscript discussed the complexity of the emergence of psychoanalytic practices in Berlin, London, and Calcutta. It raised the question as to what role Freud actually played in the invention of psychoanalysis, particularly in remote places

like Calcutta. Moreover, the section raised questions about what kind of patients received psychoanalytic treatment, what kind of diagnoses were common, how the psychoanalytic setting was designed, and what kind of effects the treatment had on patients. The third section discussed the significance of emotions in psychoanalytic therapy and its theories. The narrative focused on the role of energetic language in psychoanalytical conceptions of the mind as well as on the emotional dimension of the oedipal structure.

The chapter also explored the role of emotions in the psychoanalytic movement and in the popular reception of psychoanalysis. The final part studied the political dimension of psychoanalysis. The project aimed at exploring the political potential of psychoanalysis by discussing postcolonial, feminist, and other criticisms, as well as Freudian-Marxist approaches. At the same time, the project argued that the long-term political significance of psychoanalysis lies in its allegedly apolitical nature, in its practical knowledge about the self.

In 2016, the manuscript *Zuviel der Liebe. Die Weltgeschichte der Psychoanalyse in Berlin, London und Kalkutta 1910–1040* was successfully defended as a *Habilitationsschrift* at Freie Universität Berlin. It is currently being prepared for publication with a German publishing house.

### Emotions and Knowledge in Health Education Films and the Shaping of the Modern Subject in the 20th Century

Science has long conducted research on emotions and has significantly shaped how they are perceived. Moreover, visual media, and film in particular, substantially changed the way knowledge and emotions were produced, circulated, and received in the 20th century. Thus, the project examines the relationship between emotions and knowledge in both East and West German sex education films and their close ties to film production in France and the United States.

Analyzing the concrete effects of discourse, the project shows how experts in medicine, psychology, pedagogy, and film theory constructed the notion of “endangered” audiences who could be reached by triggering certain emotions: fear for soldiers in World War I; shame and disgust for the general public in the interwar period; fear and trust for soldiers in World War II; and empathy and humor for “youth” in the postwar era. Important is the insight that the identification of certain audiences with particular emotions has come to shape our contemporary understanding of the transfer of knowledge through the media and our understanding of the relationship between perception, cognition, and (moving) emotions. The study illustrates how sex education films were intentionally developed as an “emotional engineering technique.” Based on a filmic dispositive approach, it explores the international and transnational

media alliances and visual iconography that informed the production of sex education films in Germany and details the ways films used visual devices and novel film techniques to develop “scientifically emotionalized moral tales” with the aim of preventing the spread of disease and encouraging certain sexual practices and precautions. In doing so, these films helped shape contemporary interpretations of the human subject as a “preventative self” and reinforced practices of self-optimization. For this reason, the study also treats recipients’ reactions to, and rejections of, this advice. Finally, the project details the ways psychologists and sociologists used these films in experiments on the transfer of emotions and knowledge and on the conditions under which (health) behaviors and attitudes can be addressed and changed. Combining these different perspectives and methodological approaches, the project thus shows how the deployment of film as a new educational tool worked in practice and how the history of these films can be understood as a negotiation of the modern human subject in different political systems (Weimar democracy, National Socialism, Allied Occupation, West Germany and the GDR). It ultimately demonstrates that the historical construction of an emotional but “paradoxical self” was strongly shaped by the sciences and by international exchanges.

### Researcher

Anja Laukötter

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## Researcher

Juliane Brauer

## Key Reference

**Brauer, J.** (2015a). Disciplining young people's emotions in the Soviet occupation zone and the early German Democratic Republic. In S. Olsen (Ed.), *Childhood, youth and emotions in modern history: National, colonial and global perspectives* (pp. 178–197). Basingstoke: Palgrave Macmillan.

## Youth, Music, and Emotions:

### Collective Singing as a Form of Emotional Education in East Germany (1945–1973)

In 1946, children and adolescents in the Soviet Occupation Zone sang the words “We love our joyful life.” They were supposed to be happy, to help rebuild their country with dedication, and to enthusiastically demonstrate to the world that a better future was possible in the eastern part of Germany. And yet, after the end of World War II, young people faced a disastrous situation. Thus, convincing them to fulfil this vision demanded nothing less than giving them a completely new emotional education. Taking up ideas from 1930s “artistic education,” political leaders and teachers in Germany directly after the war viewed the collective singing of new songs as a key to the hearts of children and adolescents. In the first two decades after the war, hundreds of new children’s songs were composed. These new songs promised children an optimistic future and called for patriotism and the willingness to fight for a socialist utopia.

The research project uses songs and collective singing as historical sources in order to study emotional education in the GDR. It analyzes when, where, and to what end children and adolescents sang or were asked to sing. In order to draw comparisons with West Germany, the project focuses on discourses on music education and details the pedagogical methods that made them concrete. By drawing on records of youth group meetings

and practices of singing at schools, festivals, and celebrations, the project seeks to provide a multifaceted perspective on the ways in which certain emotions were communicated, encouraged, and regulated. In this fashion, the project treats political authority as a social praxis geared toward the education and mobilization of emotions.

This analysis of emotional education takes particular aim at showing how the education of young people was connected to certain expectations for the future. Celebrating them as the “leaders of tomorrow,” the socialist state promised its children and young people happiness and comfort within the collective as well as a chance to realize their individual potential, but only if they affirmed the state’s particular vision of the future. Desiring a socialist future was the only available option. This, however, led to conflicts between the youth and the state. Certainty for the future and a belief in progress were displaced by mistrust and disappointment in a generation of young people who took their own path. In the early 1970s, the state declared that “really existing socialism” had been achieved. The 1973 World Festival of Youth and Students in East Berlin thus concludes the phase of postwar history in which the GDR projected itself as a state of the future.

## Researcher

Kedar A. Kulkarni

## Key Reference

**Kulkarni, K. A.** (2015). The popular itinerant theatre of Maharashtra, 1843–1880. *Asian Theatre Journal*, 32, 190–227. doi:10.1353/atj.2015.0008

## Theatre and the Subject of Emotion:

### The 19th Century Marathi Musical Play and Popular Indian Consciousness

The project focuses on the confluence of precolonial and emerging performance genres from approximately 1790–1890 in western India. In the absence of widespread literacy in South Asia—only 6% were literate in vernacular languages according to the 1911 census—performance was a powerful and accessible medium, one that operated by uniquely spatializing its reception: One had to be in a specifically defined place among social others in order to participate. Like print media, performance also operated by circulation—both poet-performers and theatre troupes actively toured, rarely resting in any one city for long. This project considers how the repertoires of

precolonial performance were incorporated into colonial era dramatic traditions and repurposed for newly emerging social concerns. It asks: How did different performance genres enable people to feel differently toward the same topics? How were aesthetics implicated in structures of feeling, enabling certain things to be felt, while relegating others to insignificance?

This project begins with traditional performance genres whose worlds were largely historical, erotic, heroic, and epic. Balladeers traversed a broad geographical area in western India, consolidating representations and offering a systematic felt understanding of heroism,

cowardice, romance, morality, and other topics related to the behaviors of heroic figures, mythological figures, and even "regular" people. But these depictions differed significantly from emerging performance genres—the farce, the music drama, and drama translated from English. These new genres focused on different values and generated different meanings. The same historical figures in the new drama were quite different from those depicted in ballads. What was the difference, and how did the public reenvision their own pasts and futures as a result of performance?

By examining one century of performance across multiple genres, some findings

indicate a strong continuity between the stories being told, but a large discontinuity in how the stories are told. For example, epic characters who accomplish legendary feats of heroism are reinterpreted with a "softer" compassionate side in the later 19th century, in conjunction with emerging discourses of conjugality. This shift is, significantly, a generic one. Through repetition and popular appraisals, these softer tones for heroism replace the older models for example, and one can see such shifts across both genres as well as characterizations during the course of the 19th century.

### **Experiencing Designs and Designing Experiences: A Historical Analysis of the Role of Emotions in Theme Parks in the United States and Germany From the 1950s to the Present**

The theme park industry has transformed the way we think about leisure and entertainment, both of which have come to play an ever greater role in the world economy since the 1950s. Indeed, historical research demonstrates that theme parks have contributed to the emergence and consolidation of a postmodern conception of entertainment strongly based on the design, manufacture, and commodification of emotional experiences, especially happy ones.

Because they are concerned with constructing emotional experiences, this project sought to explain why theme parks should be regarded as historical examples of an "emotional industry" that simultaneously reflects and transforms the emotional life of its surroundings. Yet, despite the fact that emotions have historically played a key role in the evolution, design, and consumption of theme parks, this complex has been taken up by historians only recently.

Drawing upon sources such as archival records, newspapers, public and private reports, interviews, brochures, and ego-documents, the project had two main, interrelated objectives. First, it sought to analyze the relation between the historical transformation of notions of happiness and other positive emotions and the evolution of theme parks and

the so-called "emotional industry" in North America and Germany during the second half of the 20th century. The project showed that shifting conceptions of happiness over the last 50 years have been closely related to changes in the way entertainment is produced and consumed, to the rise of so-called emotional labor and to the increased use of high-technology design techniques and customization services in the entertainment industry and tourism. It also showed that this historical transformation is culturally dependent.

Second, the project sought to understand the ways theme parks as "emotional spaces" have transformed the emotional experiences of tourists over the past 60 years. This inquiry included asking how these emotional spaces have changed the way tourists search for authentic experiences and self-transformation in travel and the shifting role of emotions in tourists' face-to-face encounters with others abroad. In particular, the project compared the different ways travelers and tourists have historically faced and coped with otherness. It also showed how the increasing "thematization" of tourism has gradually changed the ways emotions are produced, consumed, and experienced by tourists.

**Researcher**

*Edgar Cabanas*

## Researcher

Margrit Pernau

## Key References

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**Pernau, M.** (2015d). The virtuous individual and social reform: Debates among North Indian Urdu speakers. In M. Pernau, H. Jordheim, E. Saada, C. Bailey, E. Wigen, O. Bashkin, M. Kia, M. Singh, R. Majumdar, A. Messner, O. Benesch, M. Park, & J. Iversen, *Civilizing emotions: Concepts in nineteenth-century Asia and Europe* (pp. 169–186). Oxford: Oxford University Press.

## Civility, Civilization, and Civil Society

Drawing on her previous work on *Civilizing Emotions* (published in the OUP-series *Emotions in History*, cf. p. 100), Margrit Pernau has embarked on an in-depth exploration of the relationship between emotions and modernity. Canonical texts on modernity from Marx and Weber to Norbert Elias and Michel Foucault have emphasized modernization as a process that increasingly disciplined emotions. Originating in the structural needs of factory, bureaucracy, and the modern state, the control of emotions moved from external enforcement to interiorization and the creation of new forms of subjectivity. This research has led to a wide range of studies on Europe and on India.

A look at the emotional expectations and experiences among the Muslims of north India from the mid-19th century to World War I, however, shows that this master narrative needs to be (and can be) made more complex through the inclusion of emotions. While the creation of discipline certainly was a very important element of the politics of the colonial state, there was also a strong counter current, geared not at the control of emotions, but at their intensification. If balance ('adl) and the avoidance of excess had been viewed as ideals

until the 1870s—never completely disappearing afterward—it was fervor and enthusiasm (josh) that became the new key value, with actors claiming that only those nations and communities that had preserved or recovered the ability for strong, hot emotions and who had not lost their vigor in the civilizing process would survive. Gender and age were important factors in this narrative. Men confidently claimed the need for strong emotions for themselves, but they believed children should learn strict discipline, and were uncomfortable with the fact that women, too, were increasingly speaking out for their right to feel passionately and to act in accordance with these feelings. Class, on the other hand, was less of an issue in north India before the war.

Not all spheres of life were equally emotionalized. While the workspace, and notably the colonial bureaucracy, continued to require discipline, the (1) family, friendship, and intimacy, (2) communities of caste, religion, and the nation, and (3) the public sphere, increasingly witnessed the display of strong emotions.

*Emotions and Modernity in Colonial India: From Balance to Fervor* has been submitted to the publisher by the end of 2016.



Figure 3. Nawab Mohsin ul Mulk, Sir Saiyad Ahmed Khan, and Justice Saiyad Mahmud.

Source. Wikimedia Commons/Unknown photographer.

## Research Area: Emotions and the Body

Attempts to overcome the stalemate between nature and nurture have not only focused on their interdependence, but have also introduced new perceptions of the relation between emotions and the body. The body is always already socially and culturally marked; at the same time, there is no society and culture without embodiment and materialization.

### Collaborative Research Activities (selected)

The workshop *Sexotic* at the Institute focused on moral economies, body techniques, media, and the interplay between sexuality and exoticization (19–20 February 2015). Assuming that sexuality—as a seemingly natural need, as a supposed key moment in the subjectivation of human beings and as an important object of state control and biopolitics—only emerged during the 18th and especially the 19th century, especially in Europe or the so-called “West,” it became reasonable to examine the history of sexuality within the context of colonialism and colonial encounters. Nevertheless, it was crucial to think of the “sexotic” not as something that concerned only the relationship between the colonizers and the so-called colonized but also to reconstruct this multilevel sexualization of the “exotic” and exoticization of the “sexual” as a mechanism of producing, of promoting, or fighting all kinds of “other” people or “other” practices, outside as well as inside the “West.” The first three panels dedicated to the topics: *Tourism, Migration, and Sex Reform* led to situations of colonial or postcolonial encounters and transfers with seemingly or truly conflicting moral economies that were also deeply embedded into an inner-

European struggle about divergent sexual politics. The fourth session on *Visual Culture* underlined the central role of the visualization of the “sexotic” through the introduction of new kinds of media, such as photography, film, or the variété. These new media did not determine but framed every kind of encounter or relationship between the “West” and its imagined “exotic” sexual “other.” Selected papers are to be published in a special issue of *Sexualities* (SAGE journals), currently in the peer review process.

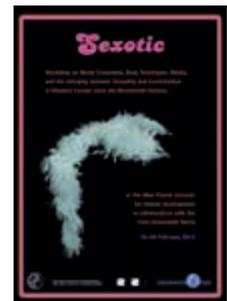
The online journal *Body Politics*, founded by Pascal Eitler, who is also member of the Editorial Board which also includes Magdalena Beljan and Joseph Ben Prestel, has published six volumes between 2014 and 2016. During this period, it attracted more than 10,000 visitors from over 100 countries, including about 2,000 from the English-speaking world. The individual volumes were dedicated to different aspects of the history of the body in the 19th and 20th centuries, such as the history of violence, the history of animals, and the history of fat. The history of emotions has served as an important point of reference for the journal's articles. It will be the focus of a forthcoming volume dedicated to the control of affects.

### Researchers

Margrit Pernau  
Bettina Hitzer  
Magdalena Beljan  
Pascal Eitler  
Uffa Jensen  
Joel Lee  
Gian Marco Vidor  
Moritz Buchner  
Imke Rajamani

### Key Reference

Dror, O. E., Hitzer, B., Laukötter, A., & León-Sanz, P. (Eds.). (2016a). History of science and the emotions [Special issue]. *Osiris*, 31(1).

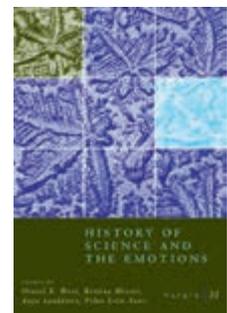


**BODY POLITICS**  
Zeitschrift für Körpergeschichte

[www.bodypolitics.de/en](http://www.bodypolitics.de/en)

“What new insights become available for historians when ‘emotions’ are included as an analytical category? The most recent volume of *Osiris* edited by Otniel E. Dror, Bettina Hitzer, Anja Laukötter and Pilar León-Sanz explores the historical interrelationships between, on the one hand, science and its cultures, and, on the other, cultures of emotions. It argues that a dialogue between the history of emotions and the history of science leads to a rethinking of our categories of analysis, our subjects, and our periodizations.

The ten case studies in the volume explore these possibilities and interrelationships across North America and Europe between the twelfth and the twentieth century in a variety of scientific disciplines. They analyze how scientific communities approached and explained the functions of emotions; how the concomitant positioning of emotions in and/or between body–mind–intersubjectivity took place; how emotions infused practices and how practices generated emotions; and, ultimately, how new and emerging identities of and criteria for emotions created new knowledge, new technologies, and new subjectivities, and vice versa.”



## Researchers

Margrit Pernau  
Imke Rajamani

## Key Reference

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## Researcher

Imke Rajamani

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**Rajamani, I.** (2016). Pictures, emotions, conceptual change: Anger in popular Hindi cinema. In M. Pernau & D. Sachsenmaier (Eds.), *Global conceptual history: A reader* (pp. 307–336). London: Bloomsbury Academic.

## Intermediality

If emotions are anchored in the body, they cannot be accessed through written texts alone. Instead, emotional experiences and expressions have to be traced through a variety of modes and media. This research project develops ways in which the interface between linguistic and nonlinguistic sources can be explored, ranging from architecture to miniatures and paintings, from popular films to poetry and descriptions of spatial practices.

### Emotional Translations

The conceptual history of emotions has been a focus of the research group since its inception: Concepts are central to the way emotions are experienced and interpreted. Margrit Pernau and Imke Rajamani have argued that emotion history can play a crucial role in moving the history of concepts beyond language by translating between reality perceived by the body and its interpretation, between concepts in different modes and media, as well as between concepts and practices.

### Monsoon Feelings

Following up on the *Emotional Translations* approach, Margrit Pernau, Imke Rajamani and Katherine Butler Schofield (King's Col-

lege London) organized a 3-day conference from 25 to 27 June 2015 at the Institute to explore Monsoon Feelings in South Asia beyond language, in intermediality, and across disciplinary boundaries. The participating experts in South Asian history and fine arts discussed how paintings, poetry, music, architecture, festivals, films, and medical knowledge document and have shaped people's emotional experiences of the rainy season from the 12th century to the present. A collective volume is currently being prepared for publication that presents the rich sociocultural history of Monsoon Feelings to a larger audience in the form of an academic coffee-table book.

### Angry Young Men:

#### Masculinity, Citizenship, and Virtuous Emotions in Popular Indian Cinema

Anger and democracy are closely intertwined political concepts—each can foster, enforce, suppress, or destabilize the other. This project investigates when, how, why, and for whom being angry became a practice of feeling Indian in a country often referred to as the world's largest democracy. *Virtuous anger* gained popularity as a political key concept in India through the cinematic figure of the Angry Young Man. The angry underdog hero, who fought in action-packed films against "the system of injustice" upheld by a corrupt establishment, is still remembered in India today as the most prominent icon of the 1970s and 1980s.

When the Angry Young Man conquered the silver screens, he turned popular Indian cinema into a central arena of political debate, contestation, and mobilization in South Asia. In order to investigate the rise and role of *virtuous anger* as an indicator and factor of political change in India, the study analyzes the emotion concept by means of seman-

tic nets that span across popular Hindi and Telugu films, magazines, posters, newspapers, and court case files. The multimedia political semantics revealed a first phase in the history of *virtuous anger* (ca. 1974–1984) where the concept functioned in support of the Nehruvian idea of Indian nationalism based on the principles of socialism, secularism, and democracy, principles represented by the Congress Party in parliament. Paradoxically, anger in defense of the ideology of democracy was used both by the Congress and the Angry Young Man as its fictional advocate to justify drastic measures against oppositional forces as well as measures of authoritarian—and thus antidemocratic—governance. The study then identified a turning point in the history of *virtuous anger* around 1984, after which the concept became an important emotional factor in the rise of *Hindutva*, a populist and chauvinist ideology promoting Hindu hegemony. Activists of Hindu fundamentalist politics used Indian cinema and its popular

images of angry citizens and vigilante action to attract young men to their organizations. Finally, the study identifies *virtuous anger*, *victimhood*, and *citizenship* as a coconstitutive semantic complex that underlies varied protest movements, with the potential to fuel conflict and radicalization in India and beyond.

The findings of the research were submitted to the Freie Universität Berlin as a doctoral dissertation in March 2016. Imke Rajamani successfully defended her dissertation on 22 June 2016 and passed the examination with distinction (*summa cum laude*). She is currently preparing her dissertation for publication.

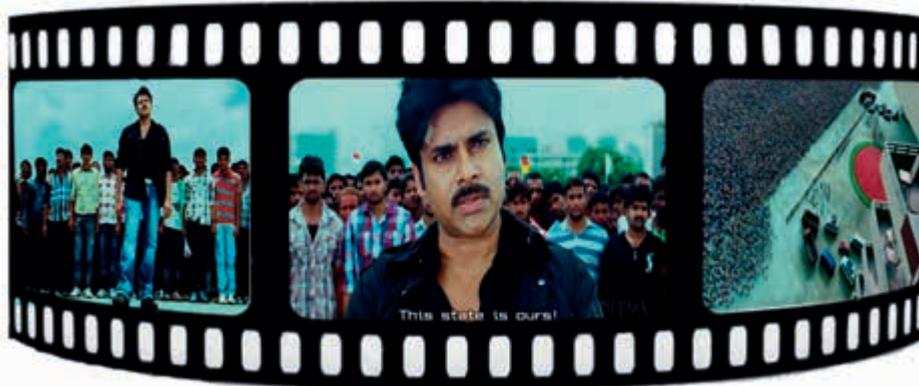


Figure 4. Angry Young Man Rambabu (Pawan Kalyan) mobilizes the citizens of Andhra Pradesh to free the South Indian state from the rule of corrupt politicians.

Source. Film still from Telugu movie *Cameraman Gangatho Rambabu* (Puri Jagannadh, 2012).

### Disgust (*Ghṛinā*) and the Visceral Life of Caste

Caste and untouchability, despite the widespread abandonment of the ideological premises on which they are generally understood to rest, persist in everyday life in South Asia with both force and subtlety. Prevailing theories of caste—as civilizational episteme, as cynical vote-bank politics, or as a fusion of Brahmanical sociology and colonial governance—explain a great deal, but they do not sufficiently account for the ongoing *visceral* life of caste, the grip it has on bodies and passions, and its effects beyond being a mere “state of mind.” This project addresses the sensory and spatial media through which caste is communicated and the affective-emotional effects that it induces in order to better comprehend how caste and related religious forms of belonging and othering actually operate.

Following Gopal Guru’s claim that studying phenomena such as *humiliation* and their textual representations might help reorient

the study of caste, the research project focuses on passions excited by encounters at the boundaries of caste society—encounters between “touchable” and “untouchable,” *āshraf* and *ārzal*, “general” and “Dalit.” Through an examination of a range of Urdu and Hindi texts from the late 19th century to the present, and through interviews and oral histories in the north Indian cities of Lucknow and Varanasi, the work tracks continuities and changes in the deployment of *ghrinā* (disgust) and related emotion-concepts (*nafrat*, *zillat*, *āpman*), which play a disproportionately large role in the representation of untouchability in Muslim and Hindu contexts in the modern period. This project both draws on and informs the author’s concurrent ethnographic work in north India, which addresses questions of Dalit religious and social history, the politics of recognition in postcolonial South Asia, urban infrastructure and sanitation labor, and the politics of smell.

### Researcher

Joel Lee

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## Researcher

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## The Love of Animals: On the Political History of an Ambivalent Emotion

This project deals with the emotionalization and politicization of human–animal relations from the mid–19th to the end of the 20th century. It focuses on developments in Germany while positioning them within a broader western European and North American context.

The project has three main findings:

First, it demonstrates how changing conceptions of animals and humans as animals challenged common knowledge about emotions ("feelings," "affects," "sensations") during the second half of the 19th century and how, in turn, shifting ideas about emotions affected perspectives on animals. The clear distinction between human and animal became less stable because complex emotions were now being ascribed to certain animals, particularly popular pets such as dogs and cats. Emotions became a powerful link between humans and other animals, not only in evolutionary theory but also in physiology and psychology, philosophy and theology.

Second, the project reconstructs the diverse ways in which animals were emotionalized in daily life. Drawing on children's literature and advice manuals, the project shows how the family has functioned as an emotional contact zone for both humans and their pets from the 19th century onward. Drawing on the practical

turn within emotion research and animal history, the project also discusses the question as to whether this emotionalization only represented the feelings of humans toward specific animals or whether it really produced specific emotions within these animals as well.

Third, the project demonstrated that this emotionalization became the basis for a politicization of human–animal relations in Germany after the mid–19th century. The animal welfare movement did not simply discover the emotions of animals, but rather ascribed emotions to them and made emotions the underlying condition for animal rights. In doing so, it reproduced a very hierarchical order between humans and their emotions: The emotionalization and politicization of human–animal relations went hand in hand with distinctions between "civilized" and "barbarian," "healthy" and "sick," "middle class" and "under class," and "German" and "Jewish" emotions.

The project thus argues that contemporary debates on animal welfare are rooted in an ambivalent political history. If animal emotions are no less socially produced than human emotions, politicizing these emotions always means reproducing them in a specific way. It implies doing something not only to humans but also to other animals.

## Researcher

Magdalena Beljan

### Key Reference

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## Love Works: Artist Couples in the 19th and 20th Centuries

Artist couples are hyped up by pop culture as the ultimate love couples, connected not only through their "intense feelings" for each other but also through a shared passion for their profession. The project questions this romantic and ahistorical view on love and artist couples and investigates the historically changing relation of emotions and work among German and US–American artist couples in the field of fine and applied arts from the late 19th century onward.

As the field of fine arts opened up to female artists in the beginning of the 20th century, artist couples became more and more common, especially in avant-garde movements and art colonies. Love and work became central for the formation of selves in the 20th century, and art can be seen as a field particularly impacted by this process. Never-

theless, artist couples did not automatically overcome traditional expectations on gender roles. While communication about art seems to be integral for the exchange of emotions and even for falling in love, the life as artists often clashed with traditional expectations regarding gender roles. Better understanding artist couples will not only give us a better idea of how conceptions of love and romance changed over time but also how creative networks functioned. A closer look at couples at the German Bauhaus, for example, shows that romantic relations seemed to be highly important for the development but also for the stabilization of social and creative networks of artists in the 20th century.

The project *Love Works* is part of the Dahlem International Network Junior Research Group

## KUNST-PAARE

For a full description of the group and the individual projects, see their homepage [www.kunst-paare.de](http://www.kunst-paare.de)

Kunst-Paare (Art Couples)—a collaboration of young researchers funded for 3 years by the Excellence Initiative and run by the Freie Universität Berlin and the MPI for Human Development, Berlin. The research group inquires into relationship dynamics and gender relations in the arts and will organize group

presentations and workshops. Two international workshops are planned for the first half of 2017: *Feeling Close: A Workshop on the History of Intimacy in the 20th Century* and *Mediality Couples: Relation Works Between Images and Performances*. Initial findings will be published in an edited volume in May 2017.

### AIDS and Emotions

Emotions like anxiety and fear have played a prominent role in the history of AIDS and HIV. However, the etiology of these emotions and the ways in which they are experienced are often sidelined, as if they, unlike AIDS itself, had no history. By discussing the ways in which politics, media, and self-help groups like the Deutsche AIDS-Hilfe in (West) Germany addressed and shaped emotions, the book elucidates the how and when of emotions' historical significance or lack thereof.

### Grief and Mourning of the Italian Bourgeoisie (1860–1915)

Feelings related to death had a significant public presence in late 19th-century Italy. Pompous funeral processions were common, as was publishing obituaries in newspapers and booklets, while many graves in ornate cemeteries were designed by famous artists. But why did death and grief play such an important role in a society that was undergoing secularization and rationalization? This project explored the practices of grief and mourning in Italy from the foundation of the liberal nation state to the beginning of World War I. It argued that a specifically bourgeois-elite culture of mourning established itself, but that it was soon contested by new social dynamics. Grief served as a way for the upper and middle classes to set themselves apart from other groups, such as the lower social classes and the population of southern Italy and the countryside. Additionally, the new, "decent" style of mourning was seen as "modern" and "civilized" in contrast to the old, "wrong" practices of mourning that were perceived as being indissolubly connected with the social order of the Ancien Régime. The project explored the distinguishing features of the emotional regime of the upper and middle classes. It drew on sources such as obituaries, scientific and literary texts, newspaper articles, advice literature, as well

as letters and diaries. The work studied contemporaneous understandings of death, the social relations associated with grief, and the impact of religion and patriotism on mourning rituals. Finally, it analyzed the relationship between emotions and the body and the spatial dimension of grieving. The project was carried out in close cooperation with Gian Marco Vidor, who has also worked on grief culture in Italy.

The study concluded that grief and mourning are determined by their historical, social, and cultural settings. Using a history of emotions approach, the project identified a tension between the feelings of individuals, the importance of grief as a social virtue, and demands that emotions be controlled, which was an important feature of the self-representation of elites.

Feelings of pain and loss played an important role in the emotional culture of traditional Catholicism. In the age of secularization and nationalism, they were increasingly viewed as a hindrance to the well-being and productivity of the individual. Since the loss of a beloved person is a strong emotional experience, individuals often tried to hide their feelings and preferred reclusiveness. Hence, over the long term, grief came to be regarded as an individual, negative emotion that lacked social value.

The dissertation supervised by Ute Frevert and submitted in 2015 will be published in the prestigious book series *Bibliothek des Deutschen Historischen Instituts in Rom*.

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### Researcher

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Figure 5. Two inkblots of the Rorschach test.

Source. H. Rorschach/  
Wikimedia Commons.

## Minerva Research Focus: Emotions and Illness. Histories of an Intricate Relation

Ever since Virginia Woolf decried contemporaneous writers' silence toward illness in her 1926 essay "On Being Ill," literature has widely explored the significance of illness for human existence. However, the history of the relation between feelings and illness in the 20th century—both as experiences of the self and as scientific concepts—remains largely unexplored. The Minerva research group aims to close this gap by studying, first, the emotional history of the 20th century's most publicized disease—cancer—and second, the scientific and cultural history of psychosomatic medicine, a field that sparked many scientific, social, and political debates on the relation between emotions, mind, and body during the 20th century.

### Oncomotions: New Perspectives on 20th-Century Cancer History

In placing the role of emotions center stage, this project brings together different aspects of cancer history that are usually kept apart: the scientific history of medical research in laboratories and wards, the cultural and political history of early detection campaigns, and the everyday history of the social and individual experience of living with cancer. The first part of the project explores how and why scientific and "practical" medical concepts about emotions' impact on cancer changed during the 20th century. After cellular pathology "expelled" emotions from laboratory cancer research to the margins of medicine, the 1920s' search for a more holistic science slowly brought emotions back into the fold of cancer medicine. It was only with the invention of stress and personality tests (like the Rorschach) in the 1950s and 1960s that emotions were reintegrated into some experimental cancer research. After peaking in the 1970s, the focus of psychosomatic cancer research shifted from the role emotions played in causing cancer to their role in curing it.

Second, the project studies how emotions were used to achieve the shifting aims of early detection campaigns. While a kind of moderate fear was first thought to be helpful, the attitude toward the usefulness of fear changed during the 1920s. Later, in Nazi Germany, *concern* was prioritized over *fear*, the latter now perceived as cowardice. The return to the belief of psychoanalysis and psychosomatics that fear should be talked about helped reintroduce the emotion into early detection campaigns in the 1970s and 1980s. Third, the project examines how cancer was discussed during the 20th century. Medical,

philosophical, and theological understandings of emotions' corporeal and existential impact played a crucial role in finding an answer to the pressing question as to whether, when, and how cancer patients should be told about their disease. Until roughly 1930, safeguarding hope by "gently lying" was viewed as crucial for the chance to be cured; later, National Socialist discourse championed frankness, drawing on a notion of courage also used when talking about dying on the battlefield. In postwar Germany, cancer again became taboo: Pointing to the experiences of POWs, many regarded death by despair as a serious danger. The cancer taboo only began to dissipate in the 1960s, when a more robust concept of hope and new ideas about the salubriousness of talking about negative emotions came to prominence.

### The Search for the Whole Human: Psychosomatic Medicine in the 20th Century

The ideas of psychosomatics have become widely disseminated and accepted, both in society and in medicine. The particular appeal of psychosomatics in Germany certainly has something to do with its self-portrayal as a more humane alternative to the cold, detached world of modern medicine. Despite this "success story," a comprehensive history of the field remains to be written. A collaborative project, codirected with Alexa Geisthövel of the Institute for the History of Medicine and Ethics in Medicine, Charité Universitätsmedizin Berlin, has been designed to explore and write this history. Twenty-four authors from German, Swiss, British, Canadian, American, and Israeli universities will contribute to a book that will be submitted in 2017.

## Research Area: Emotions and Power

Feeling rules and emotional experiences are deemed decisive wherever power and power differentials come into play. In modern societies, power is regularly framed by an emotional language that addresses people's sense of honor and dignity directly or indirectly. These particular emotions can lead people to submit to, or revolt against, power, both in the economic and political sphere.

### Collaborative Research Activities (selected)

The conference *Common Room—Architecture, Democracy and Emotions since 1945*, organized by Philipp Nielsen and Till Großmann (IMPRS Moral Economies), took place in May 2016. The papers questioned how built environments have enabled, (un)intentionally provoked, and methodically educated a variety of feelings toward different forms of democratic governance through their conception, materiality and use. Architecture rendered concrete ideas about emotions and their value for democratic governance, perceived as a political claim as well as a practice. Seven panels—on *Squatting, Capitalism and Democracy, The Image of Housing, The Politics of Public Housing, Representing the State, Permanently Provisional, and Architectural Nostalgia*—illuminated how ideas about morality and conduct were inscribed into government and official architecture, particularly following World War II and during decolonization, at a time when almost all countries, regardless of actual practices of governance, claimed to be democracies or, at the very least, republics.

The findings of the conference were communicated to a wider audience in a panel discussion at the Martin Gropius Bau cosponsored by the Berliner Festspiele. Philipp Nielsen and Till Großmann convened politicians, architects, and social activists to discuss the implications of emotions on building practices and democracy in Berlin today. A relevant publication is in preparation.



Since 2014, new projects at the Institute have been exploring the links between emotions, output, human resources management, and consumer society; a reading group consisting

of researchers and doctoral students focuses on these topics. Their projects reflect the Center's strong and ongoing interest in capitalism and economy and investigate (individually and collaboratively) the ways in which emotions have been observed, generated, muted, controlled, and fueled on the level of production and consumption. The topic's relevance for the Center was highlighted by the fact that, when Ute Frevert organized the Major Theme Historicizing Emotions of the World Congress of Historians (cf. pp. 101f.), she decided to dedicate the first of four panels to *Emotions, Capitalism, and the Market*, which included talks by Anne Schmidt and others. Back in 2012, a conference at the Institute addressed the underresearched questions of how emotions have been shaped in capitalist cultures and how capitalist cultures have been shaped through emotional discourses and practices. It was the starting point for an international collaboration between Anne Schmidt and Christopher Conrad (Geneva, Switzerland), which led to a volume dedicated to the question of how bodies and affects are formed in liberal market societies. Its contributors offer new approaches from the history of emotions, affect studies, actor-network theory, and other fields to enrich the analysis of capitalist societies, addressing issues such as speculation, industrial production, advertising, and ethics.



Figure 6. New York Stock Exchange in 1936.

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## Researchers

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## Researcher

Agnes Arndt

## Feelings in Capitalism:

### Emotions and Motivations of German Entrepreneurial Elites in the 19th and 20th Centuries

If one is to believe contemporary entrepreneurs, to be an entrepreneur is not a profession, but a way of life that demands both an extraordinary ability to deal with uncertainties and risk and a desire to cultivate a certain "emotional attitude." According to this line of reasoning, it is not the capital needed to establish, lead, and maintain an enterprise that decides whether it will succeed or fail, but rather the right personality type. Today's entrepreneurial climate fosters and seeks personalities capable of teamwork but also those who are headstrong, extremely resilient, independent, willing to take risks, and capable of solving problems. In short, it demands that entrepreneurs be emotionally stable. But how are such personalities formed? Which emotional dispositions have to be trained in order to ensure entrepreneurial success and which have to be avoided?

Historical analysis demonstrates that industrialists like Werner Siemens, August Thyssen, and Hugo Stinnes were all convinced that "empathy" with oneself and with business partners was an absolute necessity. They tried to pass the ability to empathize on to their children and grandchildren. Many of Werner Siemens' letters to his brothers Karl and Wilhelm—who

led the company's branches in St. Petersburg and London, respectively—were dedicated to the question of how one should interpret the emotions of business partners abroad, how one could build trust with them, and how this trust could lay the foundation for emotions like loyalty that would, in turn, help foster good business relations. This topic is still relevant for today's entrepreneurial culture, where PR departments try to make the emotions of their employees and those they do business with into manageable objects of business practice and research. This knowledge is then transmitted in advice manuals and training seminars. The project analyzes the history of this form of entrepreneurial emotion management. Drawing on autobiographical and biographical writings, letters, estates, business school curricula, and journals and social networks dedicated to entrepreneurialism, the project seeks to grapple with the history of entrepreneurial practice. It thus takes up entrepreneurs' ties to the family, church, and civil society, as well as the individual motives, dispositions, and emotions—succinctly put emotional drives—of entrepreneurs from the late 19th century to today.

## Researcher

Anne Schmidt

## Advertising Emotions

The research project studies how advertising culture produced advertisers and consumers—two social figures inextricably linked with one another. It analyzes discourses and the ways in which they were materialized in apparatuses, artefacts, and in practices of (self-)conduct. It seeks to contribute to the historicization of the concept of the human being, "one of the least theorized categories and a veritable black box of historical analysis" (Jakob Tanner). The study poses a number of questions related to the history of emotions, which are particularly productive when researching how economic actors are subjectivized. The history of emotions helps us recognize that the modern history of the economy is not a story of the ascent of reason and the elimination of passions. Rather, the construction of subjects in capitalism has always been connected with

the cultivation of feelings. Thus, prescriptions on emotional (self-)conduct were constitutive aspects of the morality and ethics of advertisers. Historical actors assumed that specific feelings distinguished advertisers and were necessary prerequisites for being a "good" advertiser. Drawing on contemporary theories of emotions, advertisers developed not only techniques and instruments for managing their own feelings but also for structuring the feelings of consumers. Knowledge about feelings was not static and neither were practices and techniques of emotional (self-)conduct. Quite the opposite, they changed drastically over the time period in question and, as the study shows, they constantly produced new subjects. The project focuses on the period between the end of the 19th and the beginning of

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the 21st century. It centers on Germany, but takes a transfer history perspective. It draws on a wealth of different sources, including advertising journals and books, educational material and curricula, autobiographies, a wide range of multimedia advertising material, and contemporaneous literature of various

disciplines (such as economics, psychology, psychoanalysis, sociology, anthropology, and neuroscience). The findings are rounded out by comprehensive material from the archives of different German and American companies. Project status: Research is complete; half of the book manuscript has been written.

Sabine Donauer was awarded the Körber Foundation's 2014 German Thesis Award as well as the 2015 Otto Hahn Medal for her dissertation *Emotions at Work—Working on Emotions: The Production of Economic Selves in 20th-Century Germany*. In her thesis, supervised by Ute Frevert from 2009 to 2013 at the Center and submitted at the Freie Universität Berlin, Donauer shows how, beginning with the Second Industrial Revolution, science and economics took an increased interest in the feelings of workers, making them into objects of various interventions.



### Democratic Emotions: Compromise and Humility in the Federal Republic of Germany

This project investigates attitudes toward democracy in postwar West Germany. It probes the emotions invoked as well as (un)intentionally provoked in the effort to build democracy. It thus follows two inter-related paths: One traces sentiments about compromise as a part of political culture while the other focuses on ideas about architecture as expressing and shaping democratic space and emotions.

The importance of dialogue has been at the center of much literature on postwar democracy. This project studies how such dialogue was to be facilitated through procedural and spatial arrangements—be it by granting committee rights to minority parties in parliament or by designing hallways and cafeterias in parliamentary buildings in a certain way. Moreover, it examines the emotions thought necessary for such dialogue—humility, for example. Its emphasis on practice reveals that these spatial and procedural arrangements could only ever enjoy limited success in achieving the desired goals. Social Democrats in the opposition suspected some of the government's compromise proposals to be clever entrapments; Liberal delegates complained about being unable to participate effectively in committee meetings because of seating arrangements and faulty acoustics; and angry citizens sang scornful songs about supposedly lavish government buildings when passing

them on the Rhine, in turn frustrating parliamentarians working in cramped offices, the result of the government's attempt to display humility. These examples indicate not only the complex emotional interaction between government and opposition, state and citizens, but also the ways, in which both objects analyzed in this project—the arrangement of space and arrangements for dialogue—are intimately linked.

The project traces the debates and changes surrounding these two types of arrangement from the founding of the Federal Republic in 1949 to the height of left-wing terrorism in the late 1970s. Terrorism challenged attitudes both toward compromise and the limits ascribed to it as well as ideas of how to foster accessibility and dialogue between state and citizens through architecture. Following a bomb attack on the Constitutional Court, judges, politicians, and police forces discussed additional security measures. In this debate, questions of democratic dialogue, the now much more complicated feelings related to unmediated contact between judges and citizens, and continued discourse on humble architecture intersected. Emotions were crucial in connecting political theory and ideas about political space with practice. They were fundamental to the ways competing claims to participation and access—be it opposition or citizenry—were negotiated.

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### Researcher

Philipp Nielsen

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## Researcher

Razak Khan

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## Production of Space and Emotions: Memory, Nostalgia, and Muslim Identity in Rampur (19th–20th Century)

The research project explored the ways in which space and emotions are entangled with one another in the formation of Muslim histories and identities in South Asia. These issues were examined by focusing on Rampur, which was the last Muslim-ruled princely state in the colonial United Provinces and is an important political center in contemporary Uttar Pradesh, India. The project details the diverse forms that Urdu print culture and local associational culture use in order to articulate the emotion of love for land (*ḥubbu'l-waṭani*) and the sense of belonging to Rampur (*Rampuriyat*).

These shared emotions and practices have been transformed by a number of factors, including the political and social tumult of communal politics, colonialism, and the violent partition of India. The effect of the religious identity politics of the postcolonial period have been particularly important in this regard, segregating people spatially and discursively into a “Muslim ghetto,” in the words of right-wing agitators. Urdu newspapers, journals, and autobiographical literature have

served as sites where emotions, community, and subjectivity are articulated, contested, and negotiated. Rampuri identity is shaped by the emotions of love and nostalgia as well as by practices of remembrance, mourning, and forgetting. The project sought to research this local history of emotions and explored how it continues to affect the lives of Rampuris, who are divided by borders but united by shared emotions in the conflict-riddled postcolonial nation states of India and Pakistan.

The research included oral history interviews with inhabitants of Rampur. These interviews focused on residents' perceptions of the changing trajectory of their locality and the possibility of coexistence in times of increasing national and communal discord. One of the project's aims was to rethink the role of memory and emotions in the production of locality, affective archives, and history. The book manuscript *Minority Pasts: Locality, Histories, and Identities in Rampur* has been approved for publication by Oxford University Press, India.

## Researcher

Joseph Ben Prestel

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## Feeling Urban Change: Debates About Emotions in Berlin and Cairo, 1860–1910

Between 1860 and 1910, Berlin and Cairo went through profound processes of transformation. The dynamics of change in the two cities included demographic growth, economic restructuring, and the expansion of a centralized state apparatus. The project, which was completed as a doctoral dissertation in 2015, analyzed how contemporaries in both cities described the impact of these transformative processes on urban dwellers. Focusing on debates about emotions, the project revealed that authors in Berlin and Cairo voiced very similar concerns about the transformation of their cities during the second half of the 19th century.

The dissertation examined arguments about the effects of urban change that were published in German and Arabic newspapers, magazines, travel guides, and academic literature. Processes of urban change such as economic restructuring were portrayed in these sources as affecting emotions. Con-

temporaries in both cities presented shifting practices like newspaper reading or strolling through the city as engendering a transformation of emotions, including love, honor, and disgust. The analysis of police and court records in archives in Berlin, Cairo, and London showed that these debates were not limited to the academic sphere, but were inherently tied to urban dwellers' activities in these cities. Contemporary documents also pointed to the importance of these debates for notions of personhood and the conceptualization of new kinds of subjects in Berlin and Cairo. The comparative focus of the project ultimately drew attention to the emergence of similar arguments about specific “urban emotions” in both cities.

With this finding, the project took scholarly work on urban change during the 19th century in a new direction by providing a less Eurocentric and more global understanding of the historical transformation of cities in this

period. The argument that emerged from the dissertation was neither that cities all over the world became the same nor that emotions offered a universal language to make sense of urban change during the second half of the 19th century. Rather, the project demon-

strated that similar understandings and arguments about emotions shed light on specific similarities in the histories of Berlin and Cairo. In both cities, emotions provided a useful way for particular social groups to negotiate the effects of urban change.

The dissertation, supervised by Ute Frevert, was successfully defended at the Freie Universität Berlin in April 2015. The book *Emotional Cities: Debates on Urban Change in Berlin and Cairo, 1860–1910* is under contract with Oxford University Press and scheduled for publication in fall 2017.

### Emotional Citizens: Love, Loyalty, and Trust in Politics

The project studies how citizens in the modern age emotionally relate to politics. The relationship works in both directions: Politicians, the media, and others reach out to citizens, offering forms of emotional identification; citizens, either individually or as social groups, reach out to politicians, negotiating emotional investment. In particular, two sets of emotions lend themselves to forging strong bonds between citizens and their representatives in the political realm: trust (or loyalty) and national honor.

Trust as an emotional concept has seen an enormous upsurge and intensification since the late 18th century. Not only does it play a huge role in shaping social and economic relations but also features heavily in political discourse. In democratic or democratizing societies, trust has gradually replaced loyalty and fidelity. Instead of relying on people's unquestioned support and unconditional allegiance, parliamentary systems of politics tend to realize conditions under which trust—as a temporary investment—can be granted or withdrawn. Trust thus serves as a bargaining chip. At the same time, it is presented as an emotional attitude that demands constant cultivation and social support. Over the longer term, trust can never simply be retained, but has to be nurtured and sustained by conscious political and media efforts.

Another influential emotional concept that has shaped the relations between citizens and politics in the modern period is honor. Honor was initially perceived as the prerogative of the ruling Prince whose honor was rooted in his aristocratic and dynastic lineage. Since

the early modern period, at least in Europe, it was transferred to the state that the Prince represented and/or served. During the 19th century, honor became associated with nations, that is, all the citizens that made up a nation. Any offense to a nation, therefore, affected each individual citizen and necessitated violent means to protect national honor. Ultimately, it called forth each citizen to stand up for their nation's honor and defend it against foreign assaults, a conception of honor that manifested itself all over Europe during World War I.

But honor proved to be more than a political rallying cry. As evidenced by personal diaries, letters, and other ego-documents, honor also served as a powerful semantic tool to make sense of personal loss and grief during the war and thus sustain the war effort despite serious hardship and traumatic experience. While modern democracies initially tended to downplay political emotions and focus on the "rational" culture of political compromise (see Philipp Nielsen's project, p. 119), totalitarian systems chose to enlist emotional politics and propaganda. A case in point is National Socialism, which systematically mobilized emotions in line with a specific political agenda, emotions that were to be drawn upon in order to secure citizens' support for the regime's aims and goals. Research has shown how propaganda artfully crafted sensorial schemes to elicit positive or negative emotions and how the regime incorporated social and cultural practices like singing, marching, and camping in order to stage popular compliance and passionate approval.

### Researcher

Ute Frevert

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Ute Frevert

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## Honor and Shame: An Emotional History of Power

Shaming a person or group has been, as the project contends, a common practice among those who hold or strive for power throughout history. This can play out on an individual level but can also serve as a strategic device, enacted by institutions and their representatives.

The project first focused on how children have been shamed in the family, in peer groups, and in school. Drawing on the genres of children's and advice literature during the 19th and 20th centuries, the project showed that shaming had a powerful impact on children's lives. Children were usually shamed when they violated the norms adhered to by friends and schoolmates or broke the rules prescribed by parents and teachers. Both sets of norms could clash with one another, which produced deep insecurities and anxieties in children. As a general trend, norms prescribed by adults decreased in importance throughout the late 19th and 20th centuries. By contrast, peer groups acquired a greater role in defining expectations that children and adolescents had to meet. Failure resulted in shame, conceived both as an individual, interiorized feeling and as the product of collective shaming.

As a second step, the project studied the legal politics of shaming that have undergone a resurgence in the United States since the 1980s, tracing them back to traditional practices of legal shaming that emanated in Europe's Middle Ages. The pillory remained in use as a prominent shaming site in Europe up until the early 19th century. In a similar vein, public executions served the purpose of both shaming the culprit in front of large audiences and educating audiences about what to expect if they did not obey the rules. It was particularly interesting

to analyze the movements and currents that opposed such practices of public shaming. The research showed that arguments in favor of human dignity served as an increasingly powerful counterforce. Beginning in the 19th century, this argument gradually gained momentum and ultimately succeeded in delegitimizing punishments aimed at shaming the culprit. It also served to engender support for collective empathy with the culprit's sorrows and sufferings.

In a third step, the project analyzed the practices of humiliation in which states or state officials engaged against other states. If honor is viewed as a fundamental, emotional concept of states and nations then withholding honor and inflicting shame can be seen as an effective means of disempowering adversaries. The project studied the effects of this in international relations both among European states/nations and between European and non-European states/empires, with a particular focus on China, during the long 19th century. The project particularly focused on the body language of humiliation, that is, to bowing, kneeling, and prostration. It treated these postures as a language of emotion that drew on a long cultural and political tradition of deference that acquired new meanings during the period of imperialism and colonialism.



Figure 7. Daniel Defoe in the pillory, by J. C. Armytage.

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## Research Area: Law and Emotions

Law, an increasingly powerful instrument for shaping and regulating social practices and relations, entertains a close relationship with emotions. Penal law, above all, often deals with offenses motivated by strong passions and affects. During the modern period, legal debates continuously struggled to make sense of these emotions and relate them to paramount categories of free will, individual responsibility, and culpability. Such discourses had strong repercussions on how justice was administered, how defenses were framed, and how public opinion on the case was formed.

### Collaborative Research Activities (selected)

The 2-day conference at the Institute on *Criminal Law and Emotions in European Legal Cultures: From the 16th Century to the Present* (21–22 May 2015), organized by Laura Kounine and Gian Marco Vidor, convened historians and legal scholars working on the relationship between law and emotions in criminal legal cultures over a *longue durée*. Focusing essentially on Europe, it explored and discussed how legal definitions, practices, and judgments influenced, and were influenced by, moral and social codes as well as religious and ideological norms and perceptions of the body, gender, age, and social status. The conference showed how the history of emotions could be applied to criminal legal cultures: by historicizing specific emotions and analyzing how they were discussed, experienced, and perceived in a particular legal context; and by examining the ways in which emotions, emerging from legal contexts and practices, could be valuable diagnostic tools, casting new light on more traditional themes of historical analysis, such as power, religion, morality, and scientific knowledge. Participants explored the (emotional) experience and subjectivities of legal professionals and the way that everyday people encountered the law as plaintiffs, defendants, or witnesses and how these people understood strategically used and even tried to oppose, the law's understanding of emotional phenomena. Some of the conference papers have been selected to be part of a thematic section on *Law and Emotions* in the *Journal of Social History*. Based on case studies, the papers discuss continuity and change in perceptions of emotions and their place in crime and morality. While having diverse regional and temporal focuses, all the essays share a focus on the courtroom

as an emotional space. They explore how those taking part in a trial handled different forms of knowledge about emotions in the practice of law in accordance with, or in opposition to, general social and cultural attitudes and public opinion. They investigate the presence, absence, and meanings of emotions in the courtroom as a fundamental aspect of criminal law practices. Furthermore, they take into consideration not only the emotions that were shown, expected, and provoked but also those which were repressed, controlled, or proscribed by different legal actors and the public.

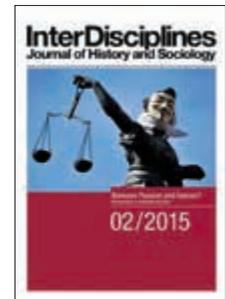
Legal regulations and practices were also identified as important tools for shaping the emotional setting of gun cultures. The workshop *Recht und Gefühl: Zur historischen Relevanz einer konstitutiven Beziehung* (Law and Emotions: The Historical Relevance of a Constitutive Relationship), organized by Dagmar Ellerbrock together with Sylvia Kesper-Biermann in cooperation with the LMU Munich, explored the interdependency between emotions and law. The workshop discussed the emotional dimensions of legal cultures and the shifts they have undergone from a historical perspective. It showed that passions influence legislation and senses have always been a part of the juridical process. It also proved that law regulates emotional behavior and that legal procedures often arouse emotions. Although passions and emotions have been woven into the texture of law, this link had been neglected since the Age of Enlightenment advocated passion-free legal procedures. Only recently has the inevitable presence of emotions in all aspects of the legal system reassumed its position as an important object of research.

## Researchers

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## Researcher

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Frevert, U. (2014f). Honour and/or/as passion: Historical trajectories of legal defenses. *Rechtsgeschichte—Legal History*, 22, 245–255.

## Emotions in German Penal Law, 1794–1945

The project is divided into two parts that are connected by a single question: How does penal law make sense of, and deal with, emotions? In its first part, the project studies so-called crimes of passion—that is, manslaughter or murder—that were allegedly motivated by strong feelings of deception, betrayal, or maltreatment. Comparing different legal systems—in France, Britain, the United States, Germany, and Italy—during the modern period, the project analyzes the ways in which legal experts and lawmakers attempted to deliver justice in cases where the perpetrator had acted in a highly emotional state. On which grounds did they define “fits of fury” as something that could be viewed as a mitigating circumstance or permit attenuating judgment? The project argues that, by linking fury to honor, the law helped to ennoble the perpetrator. Adultery in particular was thought to compromise the honor of husbands, thus entrenching an inherently gendered conception of honor. However, leniency of the law was mostly dependent on “heat of the moment” arguments, that is, attempts to avenge the violation of one’s honor. By contrast, jurists showed less understanding for premeditated, cold-blooded revenge killings aimed at restoring the collective honor of the family. By discriminating between notions of individual and collective (family) honor, examples from European history exhibit a

qualitative difference in comparison with modern-day honor killings. The full extent of the hypocrisy in judging modern-day (Muslim) honor killings, however, becomes apparent when considering that gendered concepts of emotions and honor only disappeared from European legal thought after the 1970s, partly following feminist criticism.

In its second part, the project investigates how legal systems have dealt with emotions that were strongly connected to religious beliefs and practices. After laws against blasphemy were altered (since God apparently could not be insulted), the emphasis shifted toward protecting religious believers from having their feelings offended by those who did not share their beliefs. This was done very differently in different national legal systems, as the comparison between the Anglo-Saxon countries, France, and Germany will show. But even within Germany, public and legal opinion changed throughout the 19th and 20th centuries. For a long period, the law treated religious insults as a breach of peace; in other times, however, it accorded religious feelings their own legal status and penalized every offense, regardless of its effects. By examining legal debates and linking them to social, political, and cultural developments in particular societies, the project seeks to understand how and why religious feelings have mattered to societies and needed—or not—legal protection.

## Researcher

Sandra Schnädelbach

## Key Reference

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## Feeling the Law: Concepts on the Relation Between Emotion and Judgment in German Jurisprudence 1870–1933

One goal of the project is to move past the long-spun narrative that situates law and legal decision making in the realm of “cool” rationality by taking a closer look at narratives of “feeling the law.” Judicial emotion, legal intuition, and a feeling for justice were equally prominent concepts around 1900. During the late 19th and early 20th century, a number of jurisprudential texts focused on the role of *Rechtsgefühl* in law and legal practice, debating whether this term denoted an innate sense of justice, a common feeling for the law, or a trained juristic intuition. Beginning with these debates, the project inquires into the meaning that was attrib-

uted to emotions within theoretical accounts of the genesis and legitimization of law. It discusses the influence of contemporaneous natural sciences on the function of emotion within jurisprudence and on ideas about (legal) science and emotion. Finally, it looks at how shifting concepts of emotions shaped debates on methods of legal decision making. Was it acceptable for a judge to consult his *Rechtsgefühl* when making a judgment? What was the relationship between the *Rechtsgefühl* and the particular form of emotion management expected of jurists in the courtroom? The expanding crisis of the German justice system in the late Wilhelmine years

and the Weimar Republic gave the debate on the *Rechtsgefühl* urgency: Increasingly under the eye of a critical public and growing mass press, judges had to "stage" the management of their emotions in the courtroom.

Juristic emotion management also had a social function, and issues of gender and class often determined definitions of what constituted successful emotion management. Analyzing the ways jurists were socialized as

well as the space of the courtroom and the jurist's tone, voice, and rhetoric, the project examines courtroom practices as a means of stabilizing or challenging existing norms of emotion management. Records on disciplinary hearings against judges show how feelings of authority and honor were central in defining the limits of emotional expression in court and how these feelings were undergoing changes at the turn of the century.



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Figure 8. Facing the Jury. Woodcut by Ludwig Manzel, ca. 1890.

Source. Allgäuer Online Antiquariat, Memmingen.

#### Passions at Bar: Crimes and Emotions in Italian Penal Law in the 19th and 20th Centuries

Between the 1870s and 1920s, Italy's intense debates on crime, criminals, and penology produced a wealth of analyses and theories. The focus of criminological debate shifted from the crime to the criminal, from what used to be a purely philosophical and juridical entity to a social and physical individual. This shift had a great influence in reframing perspectives on the relationship between human emotions and criminal deeds. On this matter, the so-called crimes of passion are particularly revealing for the historian of emotions. Drawing on concrete case studies, this project critically analyzes the figure of the criminal of passion as a complex legal, medical, social, and cultural construction. Preliminary findings (to be published in a volume titled *Emotional Bodies: Studies on the Historical Performativity of Emotions*, edited by Dolores Martín Moruno and Beatriz Pichel, University of Illinois Press) demonstrate that this legal debate gave new impulses to the physiology and psychology of human emotional phenomena, impulses that went far beyond questions of legal responsibility and mitigating circumstances in criminal trials.

The project also seeks to place crimes of passion in a larger context by taking up theories

and concepts of emotions that were contained in, or shaped by, theories of criminal law, codified legal norms, and new forms of legal and medical knowledge, such as criminal anthropology, forensic psychiatry, and criminal sociology. Which emotions were considered to have explicit juridical relevance or, on the contrary, implicit and indirect relevance, and why? A preliminary analysis of the role of emotions in the Italian criminal penal system will be published in an article currently under peer review by the journal *Crime, History and Society*.

Finally, the project has also explored the performative dimensions of emotions in Italian legal practices and rituals in the courtroom and especially in the court of assizes. It has sought to understand the emotional dynamics that influence the run of the trial. It asks how emotions were treated in rhetoric; how they were strategically used, staged, scrutinized, judged, and portrayed; and how this dynamic both influenced, and was influenced by, questions of gender, social class, age, and power relationships between individuals, groups, institutions, and forms of (scientific) knowledge.

#### Researcher

Gian Marco Vidor

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## Researcher

*Daphne Rozenblatt*

## Key References

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**Rozenblatt, D.** (2016). The assassin's smile: Facial expression as political expression. *History of Emotions—Insights into Research*. doi:10.14280/08241.48

## The Politics of Malice:

### Law, Science, and Violence Against the State in Modern Europe

This project focuses on the politics of emotions in political crime trials in modern Europe. During the long 19th century, non-institutional political actors increasingly used assassination as a means of political action. Notwithstanding the close association of such violence with anarchism, actors of several political stripes executed attacks to subvert governmental policies or undermine the political system as a whole. But a successful assault on the state was less a matter of the murder itself than the discourses it spawned. Thus, the trial became a central battleground in which the prosecution, defense, scientific experts, journalists, and the assailant her/himself used a range of practices to explain and judge political violence. Courtroom procedures turned from the crime to the criminal, attempting to explain who a defendant was instead of what he or she did. Highlighting the psychological, physical and, importantly, emotional makeup of the defendant, these legal processes served a further purpose: depoliticizing the defendant's motive and, in turn, politicizing character and feeling. For jurists, scientists, and journalists, the character of the political criminal was the subject of heated debate, reflection, and redefinition. As theater, laboratory, and interrogation room, European courts tried the "modern soul."

At the crossroads of law, science, politics, and popular media, the modern trial is familiar territory for historians. However, the history of emotions gives a new perspective on the politics of emotional practices and styles that conflicted with the law as an emotional regime. For instance, the defiance of a killer's smile or insistence on revenge as a valid form of justice challenged notions of correct or incorrect feeling within courtroom jurisdiction. The increasing use of psychiatric expertise to explain criminal motives, changing notions of insanity and its conflation with deviance, new styles of political violence, and the emotional dispositions of rogue political actors contributed to the emotional redefinition of legal concepts such as malice. Emotions came to define motive over and above conscious intent and how the legal and scientific adjudication of political crime legitimized and materially enforced state standards of feeling. Describing the cause of political violence as the enemy within served a further purpose: as a psychological threat, political murder by citizens contrasted with the civilizational menace posed by foreigners, protecting the legitimacy of the modern state as a representative government based on consensus.

## Researcher

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## Key Reference

**Vasilyev, P.** (2017). Revolutionary conscience, remorse and resentment: Emotions and early Soviet criminal law, 1917–1922. *Historical Research*, 90(247), 117–133. doi:10.1111/1468-2281.12173

## Emotions in the Early Soviet Courtroom

The project interrogates the role of emotions in early Soviet legal thought and practice. The project focuses in particular on the experimental legal model of "revolutionary justice," which existed relatively briefly from 1917 until 1922. In this period, there was no penal code in Soviet Russia and the judges were officially supposed to be guided by their revolutionary feeling of justice and not to be confined by formal "bourgeois law." In the absence of clear judicial procedures and codified norms, early Soviet defendants also seemed to have more procedural freedom to appeal to the judges and their emotions. Following Terry A. Maroney's definition of law and emotion scholarship as "a multidimensional engagement with various foci," several analytical approaches are incorporated,

including focusing on particular emotions, legal debates, and the performance of legal actors in the administration of justice. Drawing on an extensive range of published and unpublished materials, including numerous investigatory reports and trial records from the Central State Archive of St. Petersburg (TSGASPB), the project shows the influence of emotions on the administration of justice, the performance of legal actors in the courtroom, and the framing of defense—while at the same time highlighting substantial discrepancies between the writings of legal scholars and the actual implementation of the new legal model. These findings are further situated and discussed in the context of early Soviet ideas about the malleability and perfectibility of human nature, the emergence of the new

Soviet person, and the transformation of the deviant and the social order.

The first results of this project are published in an article in a special issue of *Historical Research* showcasing new approaches to the history of revolutionary Russia. This piece attempts an "emotional" intervention in the field of early Soviet legal history and provides a theoretical background on the role of emotions in early Soviet legal thought and practice. An additional manuscript for the 2017 special issue of *Rechtsgeschichte/ Legal History* on law and emotions in modern

### **Barbarous Jealousy:**

#### **Law, Homicide, and the Passions in Southern Italy, 1650–1800**

This project explores the relationship between law, homicide, and the passions in 18th-century Italy. The initial question was: Why did jealousy emerge as a crucial explanation for high levels of homicide in 18th-century Italy? How did new thinking about the emotions of homicide shape legal practice? A variety of legal texts, correspondence, and trials indicated that new concerns stemming from political economy around the "quality" of the peasantry caused Italian reformers to identify jealousy as a social problem. The larger context of this was the development in thought about how government, through legislation, could influence feelings and behavior. The most important explanation given for violent disorder in southern Italy was that prior legal regimes, those that came after the fall of Rome ("barbarian" laws), inculcated passions and customs that caused homicide. The admixture of laws instilled passions that caused vindictiveness and jealousy. What developed amongst many thinkers was hope for rational reform of the legal situation of the Kingdom of Naples. The 1770s and 1780s saw an increasing reception of models of law that gave a central place to educating passions. Laws were seen as tools to channel human passions. Moving from legal thought, the reality of certain controversial legal practices

Europe adopts a broader perspective and considers a longer history of German and Russian debates about the role of emotions in legal judgment.

Additionally, a monograph tentatively titled *Revolutionary Law and Revolutionary Feeling: Emotions, Crime and the Administration of Justice in Early Soviet Petrograd* (planned submission date: early 2017) will be the first book to explicitly bring together the history of emotions theoretical framework and the field of early Soviet legal history.

criticized by such reformers was examined: forgiving crimes as well as victim-controlled prosecution. The project demonstrates that an element of early modern criminal law was challenged both conceptually and practically: the right that injured parties (especially the kin of the murdered) held to both prosecute and forgive offenders. Opponents saw this system as compromised by both private hatred and undue clemency. Their new approach saw an active role for prosecution at the service of public rather than private interest. The practice of legal forgiveness was explored in "Forgiving Crimes in Early Modern Naples" and will be discussed in a broader frame in "The Emotions of Victims and Legal Change in Europe, c. 1650–1800," forthcoming in *Rechtsgeschichte*. From the focus of this project emerges a methodological interest in explanations of long-term trends in homicide. Recent historiography of homicide sees trust in government and fellow-feeling amongst citizens as the most important factors in homicide rates, but without critical analysis of such emotional factors. The review article in preparation, "Emotions and Long-Term Changes in Homicide Rates," will assess the assumptions of the historiography by bringing them into contact with methodologies drawn from the history of emotions.

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### **Researcher**

*Stephen Cummins*

### **Key Reference**

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## Researcher

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Ostling, M., & Kounine, L. (2016). Introduction: "Unbridled passion" and the history of witchcraft. In L. Kounine & M. Ostling (Eds.), *Emotions in the history of witchcraft* (pp. 1–15). Basingstoke: Palgrave Macmillan.

## Emotions, Gender, and Selfhood in German Witch-Trial Narratives

This project examines emotions, gender, and selfhood as conceptualized and experienced through the lens of witch-trial narratives in early modern Germany. It charts new territory in two critical ways. Where many history of emotions studies have remained on the level of representation—focusing on the norms and discourses of emotions at particular points in history, in legal, medical, theological, philosophical writings, and in visual and textual media—the project demonstrates how historians can go further to explore how thoughts and feelings could be articulated, expressed, and repressed. Second, this research shows how the history of emotions expands our understanding of major subjects of historical enquiry. The history of emotions sheds light on how gender norms were experienced and contested by individuals at the moment of the witch trial. And the history of emotions, by homing in on the interface between norms and individual experience, sheds light on the history of selfhood and subjectivity, themselves emerging as topics of major historical interest.

The project draws on highly rich trial records of accused witches to provide nuanced readings of the emotions, subjectivities, and selves imprinted in the testimonies of the men and women caught up in early modern witch trials. By tracing patterns in the language

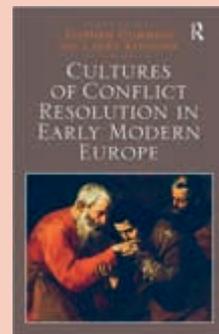
of witch-trial narratives, it becomes clear that common folk made sense of themselves and their situation through the idioms of conscience, heart, and soul, idioms that were deeply entangled with the Lutheran worldview. The project demonstrates, therefore, that we should no longer think—as has been the dominant historiographical interpretation—of early modern common folk as only conceiving of themselves as situated within a network of social relations while attributing the higher realms of interiority to their elite counterparts. Nor should we remain trapped in chronologies of selfhood that focus on the Enlightenment as the key moment of change in the development of the "modern self." Rather, this work shows that multifaceted, and at times conflicting, notions of personhood emerged in these trial records, notions of personhood that were related to other categories, such as age, social status, and gender. Through this approach, the project demarcates the ways in which these selves were experienced and given meaning at a particular moment: that is, in the moment of being on trial for a charge of witchcraft. This work is forthcoming in *Imagining the Witch: Emotions, Gender and Selfhood in Early Modern Germany* in the "Emotions in History" series at Oxford University Press.

## Key Reference

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## Cultures of Conflict Resolution in Early Modern Europe

Traditionally, the history of conflict in early modern Europe has been told as a story of how people learned to restrain hot emotional responses and escaped from the violent tenor of the Middle Ages. Emotions were "cooled" as civilization and law acted, respectively, as internal and external constraints. This collaborative work challenges such simple accounts of the restraint of emotions. Instead, it explores the complex emotional contexts and attractions of law, peace making, and mediation in early modern Europe. The book is a cooperative work, directed by Stephen Cummins and Laura Kounine, exploring the interplay of law and emotions in early modernity. The book investigates the emotional codes of conflict and its resolution in this period under three major themes: peace making as an emotional practice; typologies of early modern mediation and arbitration; and the role of criminal law in conflicts.



## Minerva Research Focus: Emotions, Violence, and Peace

The *Minerva Research Focus: Emotions, Violence, and Peace* (2012–2014) studied the link between violence and emotions on multiple levels. It analyzed structural conditions and effects as well as cultural embeddedness and social interactions.

The crucial issue of civil gun cultures and how they were both founded on, and gave rise to, strong emotions was the topic of a conference that sought to understand the emotional impact of gun practices. This knowledge is central to concepts of violence prevention. Experts from Australia, Canada, the United States, Central and East Europe, and the Middle East debated on the emotions that are usually associated with gun cultures: Fear, mistrustfulness, pride, and honor. For instance, whether fear-driven actors plead for strict or loose regulation of private firearms depends on the way in which their emotions are linked to notions of gender (especially ideas of masculinity) as well as political narratives of freedom, protection, and state responsibilities. Particular shooting incidents evoke emotional shifts: They can either intensify indolence and self-centeredness or give rise to empathy and responsibility. The global comparison showed that alterations in the normative regulation of gun cultures have been guided by a modification of the emotional attachment to firearms. Media coverage was identified as an

important instrument for changing the emotional framing of gun cultures. Gun-related legislation can be considered as an important factor in defining the emotional coding of gun cultures, since the frequency of firearm use shapes emotional attitudes toward handguns. Research perspectives emerging out of this correlation were explored in a workshop on *Law and Emotions*, see p. 123 for details.

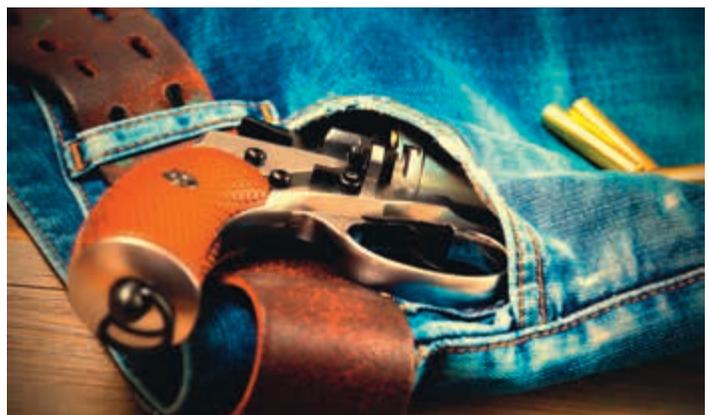


Figure 9. The myths of civil gun cultures.

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"After taking up my position as Professor of Modern History at the Technische Universität Dresden, I became an adjunct researcher at the Center for the History of Emotions and continued my collaboration with the MPI for Human Development. I held two talks at the MPI for Human Development LeadNet Conference in 2015: one at the Scientific Panel on *Understanding Violence and Gun Cultures: The Turn to Emotion* and one at the Career Session on going *From MPS to Professorship*. Together with Juliane Brauer (MPI for Human Development) and Irmgard Zündorf (Zentrum für Zeithistorische Forschung Potsdam) I organized a workshop on how to teach GDR history at historical sites, examining the emotional impact of historical learning. In May 2015, I was invited as a speaker at the conference *Criminal Law and Emotions in European Legal Cultures: From the 16th Century to the Present*, organized by Laura Kounine and Gian Marco Vidor (both MPI for Human Development). Since 2014, Juliane Brauer and Anne Schmidt have been offering seminars on the history of emotions in my academic department. Colleagues from the Center for the History of Emotions have often been invited to give talks in my colloquium."



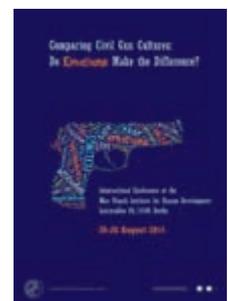
## Researcher

Dagmar Ellerbrock

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(last update: Spring 2017)

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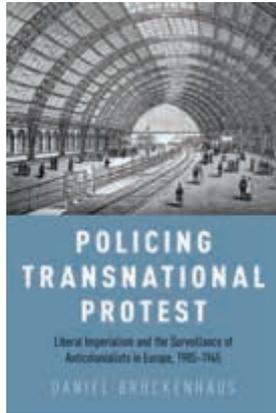
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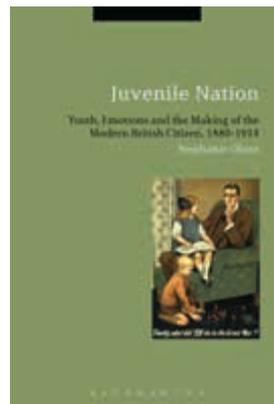
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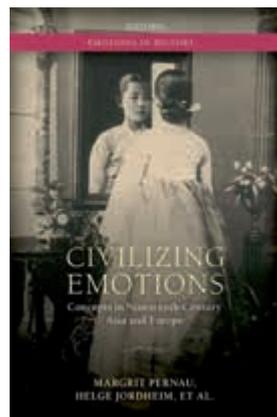
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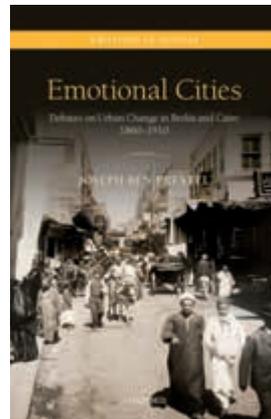
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"But ... its eminent modifiability, and its predisposition to self-initiated action, may it develop little or much, and may it differ in amount between different individuals, is among the immutable features of humankind, which can be found wherever humans exist."  
*Johann Nicolaus Tetens, 1777, I, p. 766*



J. N. Tetens (1736–1807), philosopher of the Enlightenment Era

## Introductory Overview

Founded in 1981 by Paul B. Baltes (1939–2006; Lindenberger, Delius, & Staudinger, 2015), the Center for Lifespan Psychology (LIP) pursues lifespan psychology as a distinct conceptual approach within developmental psychology. Since 2004, the Center has continuously extended its research program into developmental neuroscience. Work at the Center is guided by three propositions: (1) to study lifespan changes in behavior as interactions among maturation, learning, and senescence; (2) to develop theories and methods that integrate empirical evidence across domains of functioning, timescales, as well as behavioral and neural levels of analysis; (3) to identify mechanisms of development by exploring age-graded differences in plasticity. The Center continues to pay special attention to the age periods of late adulthood and old age, which offer unique opportunities for innovation, both in theory and practice. At the same time, it has continuously extended its research on behavioral development to earlier periods of life.

### Three Guiding Propositions

The Center's research agenda can be summarized by three interrelated theoretical propositions (Kühn & Lindenberger, 2016; Lindenberger, 2014; Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010). In line with general tenets of lifespan psychology, these propositions emphasize conceptual and methodological issues in the study of lifespan behavioral development and thereby provide a conceptual foundation for formulating research questions in specific domains of interest.

#### Proposition 1: Lifespan Changes in the Individual's Behavior as Interactions Among Maturation, Learning, and Senescence

The general goal of developmental psychology is to identify mechanisms that generate invariance and variability, constancy and change, in behavioral repertoires from infancy to old age. By identifying the commonalities, differences, and interrelations in the ontogeny of sensation, motor control, cognition, affect, and motivation, both within and across individuals, developmental psychologists and developmentally oriented neuroscientists attempt to arrive at more or less comprehensive theories of behavioral development. To provide explanations that qualify as psychologi-

cal and developmental, the effects of agents external to the developing individual, such as parents' affect attunement, teachers' classroom behavior, or a state's retirement policies, need to be mapped onto mechanisms and organizational laws that operate and evolve within developing individuals. Hence, as John Nesselroade, Peter Molenaar, and others have emphasized, individual people, rather than groups of people or domains of functioning within persons, form the privileged system of analysis and explanation.

Individuals organize their exchange with the physical and social environment through behavior (see Figure 1). On the one hand, the changing brain and the changing physical and cultural environment shape behavioral development. On the other hand, behavior alters both the brain and the environment. Hence, environment and brain act as antecedents but also as consequents of moment-to-moment variability and long-term changes in patterns of behavior. The components of this system, brain, behavior, and environment, are constantly coupled and cannot be reduced onto each other, as they jointly condition an individual's life trajectory through recursive self-regulation.

In attempts to explain the age-graded evolution of this system, *maturation* and

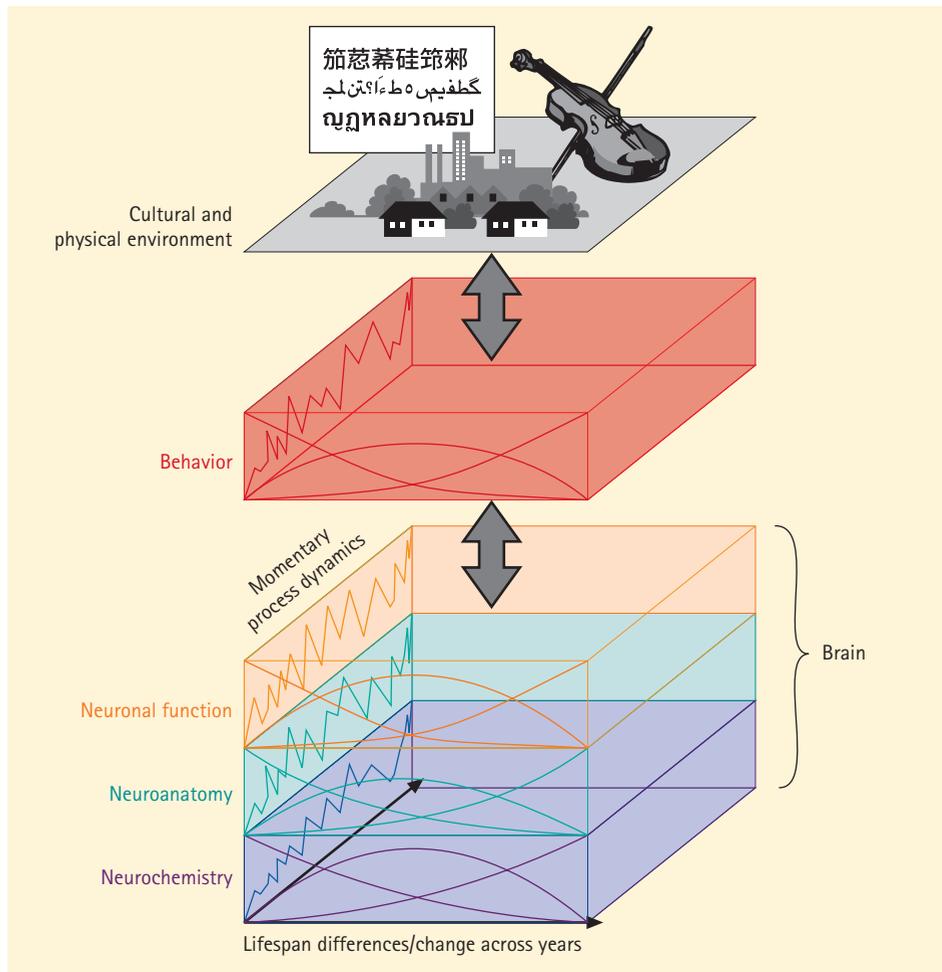
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**Figure 1.** Environment and brain as antecedents and consequents of moment-to-moment variability and long-term changes in patterns of behavior. Lifespan changes in brain-behavior mappings are shaped by interactions among processes related to maturation, learning, and senescence. The identification of key players in the ontogeny of brain-behavior dynamics requires a coalition between formal tools for synthesis across levels of analysis and timescales as well as empirical methods to study variability and change in brain and behavior (adapted from Lindenberger, Li, & Bäckman, 2006).

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*senescence* denote the operation of age-graded brain mechanisms and their effects on changes in behavior, which are especially pronounced early and late in life. In addition, *learning*, at any point during ontogeny, denotes changes in brain states induced by behavior-environment interactions. Note, however, that maturation cannot take place without learning and that learning cannot take place without maturation. Similarly, the ways in which senescence takes its toll on the brains of aging individuals depend on

their past and present learning and maturational histories. To complicate matters even more, processes commonly associated with maturation are not confined to early ontogeny and processes related to senescence are not restricted to old and very old age. For instance, neurogenesis and synaptogenesis, which qualify as maturational mechanisms promoting plasticity, continue to exist in the adult and aging brain; conversely, declines in dopaminergic neuromodulation, which indicate senescence-related changes in brain

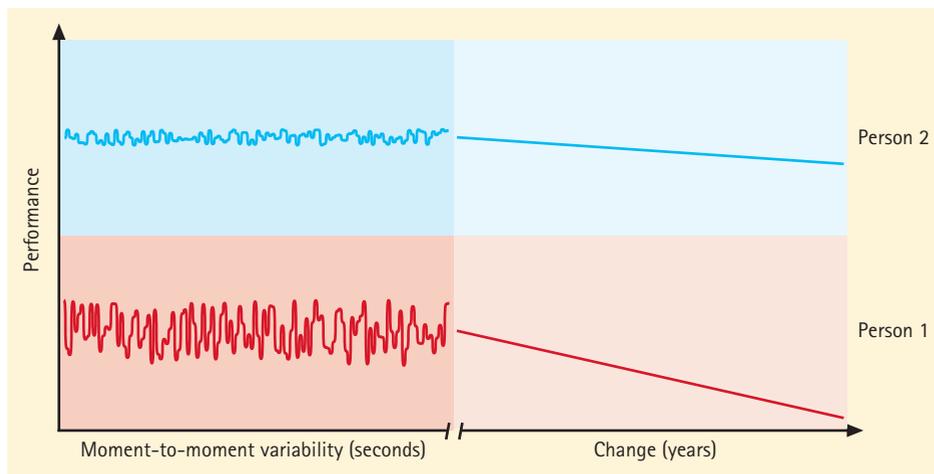
chemistry, commence in early adulthood. Thus, maturation, senescence, and learning mutually enrich and constrain each other throughout the entire lifespan and must be understood and studied as interacting forces constituting and driving the brain–behavior–environment system. Psychologists occupy a central position in this endeavor because they possess a rich and adequate repertoire of experimental and methodological tools to describe and modify the organization of behavior. In particular, direct comparisons between children and older adults help to identify commonalities and differences in the mechanisms that drive child and adult development.

**Proposition 2: Lifespan Theory and Methodology Need to Integrate Evidence Across Domains of Functioning, Timescales, and Levels of Analysis**

Developmental psychology is faced with three challenging integrative tasks. First, there is the need to integrate theorizing and research practice across functional domains to attain a comprehensive picture of individual development. For instance, sensorimotor and cognitive functioning are more interdependent

in early childhood and old age than during middle portions of the lifespan, and developmental changes in either domain are better understood if studied in conjunction. Similar observations can be made for many other domains of functioning whose changes have generally been studied in isolation, such as the ontogeny of social interaction and cognition; of emotion regulation and motivational states; or of memory, working memory, and attention.

Second, there is a need to understand the mechanisms that link short-term variations to long-term change. Short-term variations are often reversible and transient, whereas long-term changes are often cumulative, progressive, and permanent. Establishing links between short-term variations and long-term changes is of eminent heuristic value, as it helps to identify mechanisms that drive development in different directions. For instance, aging cognitive systems show a decrease in processing robustness, which may signal impending long-term changes in other characteristics of the system (see Figure 2). In contrast, other forms of neural and behavioral moment-to-moment variability may indicate an individual's ability to bring a wide variety



*Figure 2.* Example for predictions linking moment-to-moment variability to long-term change and brain changes to behavioral changes. Senescent changes in neuromodulation lead to greater moment-to-moment fluctuations in neural signaling, enhance the prominence of background noise, reduce the distinctiveness of processing pathways and representations, and increase variability of cognitive performance. Aging individuals with greater moment-to-moment process fluctuations at a given point in time are expected to show greater subsequent longitudinal decline in mean levels of functioning than individuals who fluctuate less (adapted from Lindenberger et al., 2006).

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of different strategies to the task and are positively related to long-term change in both childhood and old age (e.g., Hertzog, Lövdén, Lindenberger, & Schmiedek, in press). To articulate these perspectives, we need to gather multivariate time-series data that capture short-term variability and long-term changes in across-domain dependencies.

Third, to arrive at mechanistic explanations of behavioral change, there is the need to integrate behavioral and neural levels of analysis. At any given point in the lifespan, one-to-one mappings between brain states and behavioral states are the exception rather than the rule, as the brain generally offers more than one implementation of an adaptive behavioral outcome. Therefore, ontogenetic changes in behavioral repertoires are accompanied by continuous changes in multiple brain-behavior mappings. Some of these remapping gradients may be relatively universal and age-graded, whereas others may be more variable, reflecting genetic differences, person-specific learning histories, the path-dependent nature of developmental dynamics, or a combination of all three. The resulting picture underscores the diversity and malleability of the organization of brain and behavior as well as the constraints on diversity and malleability brought about by (a) universal age-graded mechanisms associated with maturation and senescence, (b) general laws of neural and behavioral organization, and (c) cultural-social as well as physical regularities of the environment.

### Proposition 3: The Exploration of Age-Graded Differences in Plasticity Is a Powerful Tool for Identifying Mechanisms of Development

Both from scientific and societal perspectives, plasticity, or the alteration of developmental trajectories through experience, is a precious phenomenon (Freund et al., 2013, 2015; Kühn & Lindenberger, 2016; Lindenberger, 2014). Scientifically, inquiries into the plasticity of brain and behavior are a rich source of developmental information. Through the assessment of “changes in change,” they offer the promise to observe the operation and proximal consequences of developmental mecha-

nisms. For instance, studies in which research participants of different ages are instructed and trained to perform one or more cognitive tasks come with important validity benefits, such as (a) an increase in experimental control, (b) the identification of age differences near asymptotic performance levels, and (c) the assessment of transfer and maintenance effects. If neurochemical, neuroanatomical, and neurofunctional imaging measures are assessed before, during, and after training, intervention studies also offer new insights into relations between behavioral and neural manifestations of plasticity. By partly taking control over behavior-environment interactions, mechanisms of learning can be studied in the context of maturation and senescence (Lövdén et al., 2010).

From the larger perspective of societal evolution, cognitive intervention studies explore the range of possible development, or what could be possible in principle if conditions were different (see Figure 3). The resulting

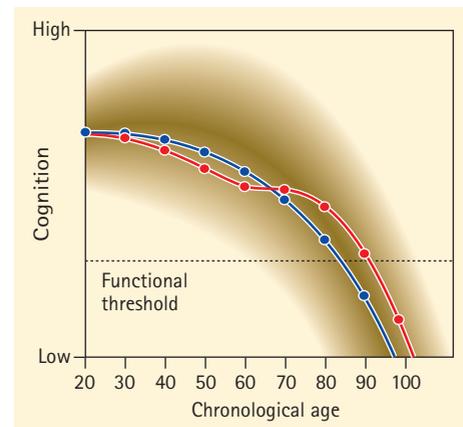


Figure 3. An individual's range of possible cognitive developmental trajectories from early to late adulthood. The blue curve shows the most likely developmental path under normal circumstances. The fading of the background color indicates that more extreme paths are less likely. The functional threshold represents a level of functioning below which goal-directed action in the individual's ecology will be severely compromised. The red curve represents the hope that changes in organism-environment interactions during adulthood move the individual onto a more positive trajectory. Beneficial changes may consist in the mitigation of risk factors, such as vascular conditions, metabolic syndrome, or chronic stress; the strengthening of enhancing factors, such as neuroplasticity; or both (adapted from Lindenberger, 2014).

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knowledge about the plasticity of developmental trajectories is essential for improving human welfare. Hence, investigations of age changes in the plasticity of development carry the potential to explain and ameliorate the expression of human potential. For all of these reasons, age-comparative intervention studies with a focus on behavioral and neural manifestations of plasticity form the core component of empirical research at the Center. At the conceptual level, researchers at the Center have aimed at identifying distinct features of plasticity in relation to other types of behavioral and neural variability and change (Lövdén et al., 2010; see Figure 4). At the empirical level, the Center has carried out pioneering studies on plastic changes in brain and behavior, such as the COGITO study (see *Intra-Person Dynamics* project, pp. 157–159). In recent years, we have launched a new generation of experiments that combine behavioral skill training with repeated functional and structural imaging to directly observe the temporal progression of plasticity in individual people. Going

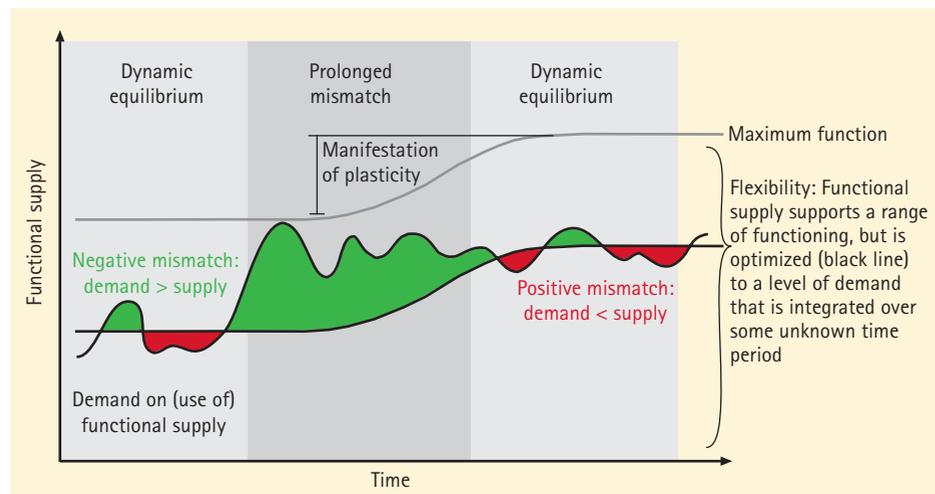
beyond the canonical pretest–posttest design of intervention studies, these studies seek to observe how plastic changes unfold over time. In this context, Lövdén, Wenger, Mårtensson, Lindenberg, and Bäckman (2013) have noted that neural manifestations of plasticity are often marked by initial tissue expansion (e.g., overproduction of new synaptic connections) followed by renormalization (e.g., pruning of these connections). Recently, we have been able to delineate this pattern empirically in human adults (Wenger et al., 2017; see *Plasticity* project, pp. 153–156; see also Lindenberg, Wenger, & Lövdén, 2017).

### Methodological Innovation

Since its foundation in 1981, the Center has sought to promote conceptual and methodological innovation within developmental psychology and in interdisciplinary context. Special attention is paid to methods and research designs apt to integrate (a) multiple domains of functioning, (b) multiple timescales, and (c) multiple levels of analysis. Random coefficient modeling, latent growth

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**Figure 4.** Schematic model of a mismatch between functional supply and experienced environmental demands caused by primary changes in demand (e.g., altered experience through cognitive training). Functional supply (i.e., the structural constraints imposed by the brain on function and performance) allows for a range of performance and functioning. Flexibility denotes the capacity to optimize the brain's performance within the limits of the current state of functional supply. Due to the sluggishness of plasticity, structural supply optimizes its support for function to a level of demand (i.e., use of functional supply) that is averaged over some unknown time period. Mismatches need to be prolonged to overcome the inertia and sluggishness of plasticity and to push the system away from its dynamic equilibrium. Deviations in demand that are within the current range of functional supply induce the mismatch that constitutes the impetus for plastic change (adapted from Lövdén, Bäckman, Lindenberg, Schaefer, & Schmiedek, 2010).

curve modeling, and related statistical techniques have served as versatile tools for the analysis of multivariate data with nested time structures, such as trials, blocks of trials, days, weeks, and years. Recently, time–delay embedding and clustering methods for time–series data, continuous-time structural equation modeling, combinations of classifier and structural equation modeling techniques, as well as machine–learning tools have been added to the repertoire (see *Formal Methods* project, pp. 172–174). Under the leadership of Gerd Kempermann from the Dresden site of the German Center for Neurodegenerative Diseases, and in collaboration with Antonio

Krüger from Saarland University, Andreas M. Brandmaier and Ulman Lindenberger have continued their collaboration on an animal model of epigenetic contributions to individual development (Freund et al., 2013, 2015). Finally, the Center closely collaborates with the Max Planck UCL Centre for Computational Psychiatry and Ageing Research (see pp. 195–200).

### Research Awards (Selection)

During the reporting period, several research awards were bestowed upon visitors and members of the Center. Andreas M. Brandmaier received the Heinz-Billing-Award

*Table 1.* The Center for Lifespan Psychology and the Max Planck UCL Centre for Computational Psychiatry and Ageing Research at the Max Planck Institute for Human Development: Overview of Research Projects

<i>Name of project</i>	<i>Researchers, including postdoctoral fellows</i>	<i>Predoctoral research fellows</i>
Lifespan Neural Dynamics Group within the Max Planck UCL Centre	Douglas D. Garrett <sup>**</sup> ; Niels A. Kloosterman <sup>*</sup> , Iris Wiegand <sup>*</sup>	Julian Q. Kosciessa
Cognitive and Neural Dynamics of Memory Across the Lifespan (ConMem)	Myriam C. Sander <sup>**1</sup> , Markus Werkle-Bergner <sup>**</sup> ; Andrew R. Bender <sup>*</sup> , Attila Keresztes <sup>*</sup> , Ulman Lindenberger, Yee Lee Shing <sup>°</sup> , Claudia C. Wehrspaun <sup>*</sup>	Martin J. Dahl, Anna Karlsson, Beate E. Mühlroth, Laurel Raffington, Verena R. Sommer
Mechanisms and Sequential Progression of Plasticity	Yana Fandakova <sup>**</sup> , Elisabeth Wenger <sup>**</sup> ; Simone Kühn <sup>°</sup> , Ulman Lindenberger	Oisin Butler, Neda Khosravani
Intra–Person Dynamics Across the Lifespan	Manuel C. Voelkle <sup>**3</sup> ; Annette Brose <sup>°</sup> , Ulman Lindenberger, Florian Schmiedek <sup>°</sup>	Janne Adolf, Charles C. Driver
The Berlin Aging Studies (BASE)	Julia A. M. Delius <sup>**</sup> , Sandra Düzel <sup>**</sup> , Ulman Lindenberger <sup>**</sup> ; Julia Schröder <sup>*</sup> , Gert G. Wagner <sup>2</sup>	
Interactive Brains, Social Minds	Viktor Müller <sup>**</sup> ; Ulman Lindenberger	Caroline Szymanski
Sensorimotor–Cognitive Couplings	Julius Verrel <sup>**</sup> ; Whitney G. Cole <sup>*</sup> , Ulman Lindenberger	Maïke M. Kleemeyer
Brain Imaging Methods in Lifespan Psychology	Nils C. Bodammer <sup>**</sup> ; Ulman Lindenberger, Naftali Raz, Davide Santoro <sup>*</sup>	
Formal Methods in Lifespan Psychology	Andreas M. Brandmaier <sup>**</sup> ; Julian D. Karch <sup>*</sup> , Ulman Lindenberger, Manuel C. Voelkle <sup>°</sup> , Timo von Oertzen <sup>°</sup>	Janne Adolf, Charles C. Driver

*Note.* Research manager of the Center: Imke Kruse. The table refers to projects and project members as of 03/2017; for updates, visit [www.mpib-berlin.mpg.de](http://www.mpib-berlin.mpg.de).

<sup>\*\*</sup>principal investigator; <sup>\*</sup>postdoctoral fellow; <sup>°</sup>adjunct researcher (primary affiliation with another institution).

<sup>1</sup> Myriam C. Sander leads a Minerva Research Group (see Box 2, p. 152).

<sup>2</sup> Gert G. Wagner is Max Planck Fellow at the MPI for Human Development (see pp. 263–268 for more information).

2015 of the Max Planck Society for the Advancement of Computational Science for his multiple statistical and computational contributions to behavioral science. Ulrich Mayr (University of Oregon, Eugene, USA) and Silvia Bunge (University of California, Berkeley, USA) were awarded Alexander von Humboldt Research Awards in 2014 and 2016, respectively, and are currently collaborating with the Center on several research projects. Simone Kühn (now at University Medical Center Hamburg-Eppendorf, Germany) and Markus Werkle-Bergner both received the Jacobs Early Career Research Fellowships of the Jacobs Foundation in 2015 and 2016, and Simone Kühn has been awarded a Starting Grant from the European Research Council. In addition to research grants from the German Research Foundation, the Federal Ministry for Education and Research, and the European Union, research at the Center has continued to profit from the Gottfried Wilhelm Leibniz Award 2010 of the German Research Foundation (DFG) given to Ulman Lindenberger, and from continued support from the Innovation Fund of the Max Planck Society.

### **Overview of Research Projects at the Center for Lifespan Psychology**

Currently, in March 2017, empirical and conceptual work at the Center is structured into eight research projects (see Table 1). The activities pursued in these projects cover a wide array of research areas in human behavioral development. For example, the following questions have been addressed during the reporting period: (a) How can we experimentally disentangle knowledge accumulation from other age-correlated processes such as cortical maturation when studying age differences in memory retrieval (Brod, Lindenberger, & Shing, 2016)? (b) Is the female menstrual cycle associated with changes in the volume and functional connectivity of the hippocampus (Lisofsky, Mårtensson et al., 2015)? (c) How can we build a unified statistical framework for the study of within-person and between-person structures (Voelkle, Brose, Schmiedek, & Lindenberger, 2014)? (d) How can we help researchers in the a-priori identification of longitudinal research designs that optimize the statistical power to detect individual differences in change (Brandmaier, von Oertzen, Ghisletta, Hertzog, & Lindenberger, 2015)? We provide our current answers to these questions and many more on the following pages.

## Researchers

Myriam C. Sander  
Yee Lee Shing  
Markus Werkle-  
Bergner  
Ulman Lindenberger

Yana Fandakova  
(until 01/2014)  
Attila Keresztes  
Andrew R. Bender  
(as of 11/2014)  
Julia C. Binder  
(as of 03/2016)

Garvin Brod  
(until 06/2016)  
Martin J. Dahl  
(as of 10/2014)  
Thomas H. Grandy  
(until 06/2016)  
Beate E. Mühlroth  
(as of 02/2016)  
Laurel Raffington  
Verena R. Sommer  
(as of 02/2016)

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Shing, Y. L., Werkle-Bergner, M., Brehmer, Y., Müller, V., Li, S.-C., & Lindenberger, U. (2010). Episodic memory across the lifespan: The contributions of associative and strategic components. *Neuroscience & Biobehavioral Reviews*, 34, 1080–1091. doi:10.1016/j.neubiorev.2009.11.002

## Research Project 1: Cognitive and Neural Dynamics of Memory Across the Lifespan (ConMem)

The overarching objective of the *ConMem* project is to provide mechanistic explanations for developmental changes and interindividual differences in various aspects and functions of memory, with an emphasis on episodic and working memory. The project proceeds on the assumption that lifespan changes in memory functioning can be mapped onto the interacting contributions of two components, one associative and the other strategic. The associative component of memory refers to mechanisms that bind different aspects of an event into a cohesive memory representation and can be linked to medio-temporal areas (especially the hippocampus, HC) as well as posterior association areas. The strategic component refers to attentional and control processes that aid and regulate memory functions and is mainly supported by prefrontal and parietal regions. Interactions among maturational, experience-dependent, and senescent forces shape the relative contributions of associative and strategic processes during memory encoding, consolidation, and retrieval.

The heuristic value of this framework for understanding lifespan age differences in episodic and working memory has been empirically validated in a series of behavioral, functional imaging (fMRI), and electroencephalographic (EEG) studies (e.g., Fandakova, Sander, Werkle-Bergner, & Shing, 2014; Sander, Lindenberger, & Werkle-Bergner, 2012; Shing, Werkle-Bergner, Brehmer, Müller, Li, & Lindenberger, 2010).

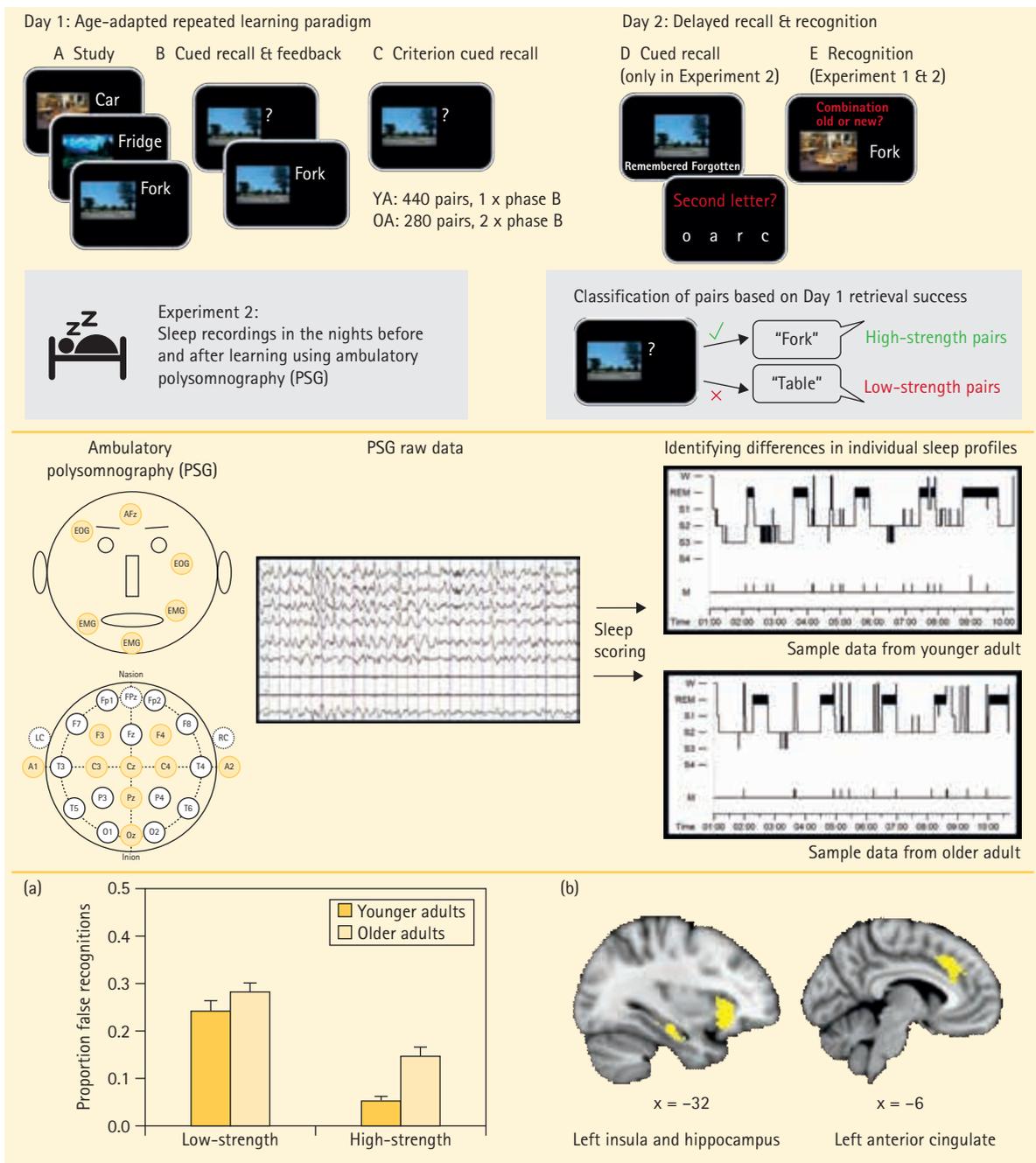
### Age Differences in the Interplay Between Associative and Strategic Components: Modulation by Memory Strength at Encoding, Consolidation, and Retrieval

Not all mnemonic events are equal. Some are encountered only once, but are vividly remembered throughout life. By contrast, other events occur repeatedly without leaving any recoverable trace. Do aging-related changes in prefrontal and medio-temporal regions weaken memory traces formed in old age? Do younger and older adults differentially rely on associative and strategic processes when forming new memories? Do mechanisms contributing to memory consolidation during sleep differ by age?

To address these questions, we designed the *MERLIN Study*, which allows us to track the mnemonic strength of single events within a given person (for details, see Figure 5). The study consisted of a multisession protocol including behavioral, EEG, and MRI assessments, as well as ambulatory polysomnographic sleep monitoring in half of the

sample. It was conducted from July 2013 to July 2015. Based on the data from this study, we are currently investigating whether age differences in the elaboration of learned scene-word pairs contribute to age differences in episodic memory performance. Preliminary results demonstrate that during initial encoding, decreases in rhythmic neural alpha activity (~10 Hz) gradually track differences in memory strength, suggesting that prolonged alpha desynchronization during encoding enables deeper semantic elaboration on individual items. Younger and older adults show qualitatively similar effect patterns, suggesting that successful encoding depends on comparable neural mechanisms across the entire adult age range. Age-associated decrements in memory performance most likely result from a decreased propensity to reliably implement similar sets of mechanisms.

Sleeping after learning benefits memory, but with advancing adult age, both sleep and memory performance tend to deteriorate. By assessing memory strength at the item level within each study participant, we seek to disentangle the effects of reduced overnight forgetting from active enhancement of initially labile memory traces (Dissertation Beate E. Mühlroth). First analyses conducted in collaboration with Björn Rasch (University of Fribourg, Switzerland) show that overnight memory enhancement was of similar magnitude in both age groups, whereas forgetting was more pronounced in older adults. Despite



**Figure 5. MERLIN Study design.** Upper panel: Participants studied scene–word pairs using an imagery-based memory technique (Day 1). After first presentation, each image served as a cue for participants to recall the associated word. Regardless of recall accuracy, the correct word was presented again, allowing further associative learning. A final cued-recall task without feedback (Day 1, C) served to classify the items as high-versus low-strength pairs for a recognition test on Day 2 (Experiment 1). Learning was monitored with EEG and retrieval was assessed with fMRI. In a new sample, we used the same paradigm, with delayed cued recall instead of recognition, and monitored sleep in the nights before and after learning (Experiment 2). Middle panel: Ambulatory polysomnography (PSG) allows monitoring of neurophysiological sleep patterns at home. Manual scoring of sleep stages revealed less time spent in deep sleep and more fragmented sleep in older than in younger adults. Lower panel: Initial analyses show increased proportions of false recognitions in older adults, specifically for high-strength scene–word pairs. Apparently, they experienced greater difficulties in identifying new combinations of overlearned material. This effect was associated with altered neural activity in insular cortex, hippocampus, and anterior cingulate.

altered sleep architecture in older adults, there were no age differences in the association between sleep physiology and memory performance. Slow wave activity and the occurrence of sleep spindles were related to overnight forgetting in both age groups. Older adults are more likely than younger adults to form partially or entirely false memories of past episodes. In collaboration with Roberto Cabeza (Duke University, USA), we sought to delineate the neural correlates of this particular pronounced age difference. While there were no age differences in false memory for low-strength pairs, older adults were also more likely to falsely endorse high-strength pairs. False recognition engaged cingulo-opercular regions. Activity in these regions increased for low-strength pairs in younger, but not older, adults, indicating age-related deficits in retrieval monitoring. We found no age differences in HC activity, which was higher for correct recognition of high-strength pairs. Higher cingulo-opercular and HC activity predicted lower false memory rates in younger and older adults, suggesting that binding and monitoring mechanisms contribute to false memory complementarily.

### HC Subfield Contributions to Memory Development

Adaptive learning systems need to meet two conflicting goals: detecting regularities in the world through generalization versus remembering specific events through disambiguation—functions implemented in the neural circuits of the HC. Animal studies suggest that HC subfields reorganize during maturation. Studying this reorganization in the human HC is technically challenging. As a result, the ontogenetic timing of HC maturation is controversial and the contribution to generalization and specification in cognitive development remains elusive. By using high-resolution in-vivo MRI data from children (6–14 years) and younger adults, we were able to identify a multivariate profile of age-related differences in intra-HC structures and to show that HC maturity as captured by this pattern is associated with age differences in the differential encoding of unique memory representations (see Figure 6). The uneven time course of HC subfield maturation identified in this study provides a mechanistic explanation for the observation that generalization precedes specification in memory development during childhood.

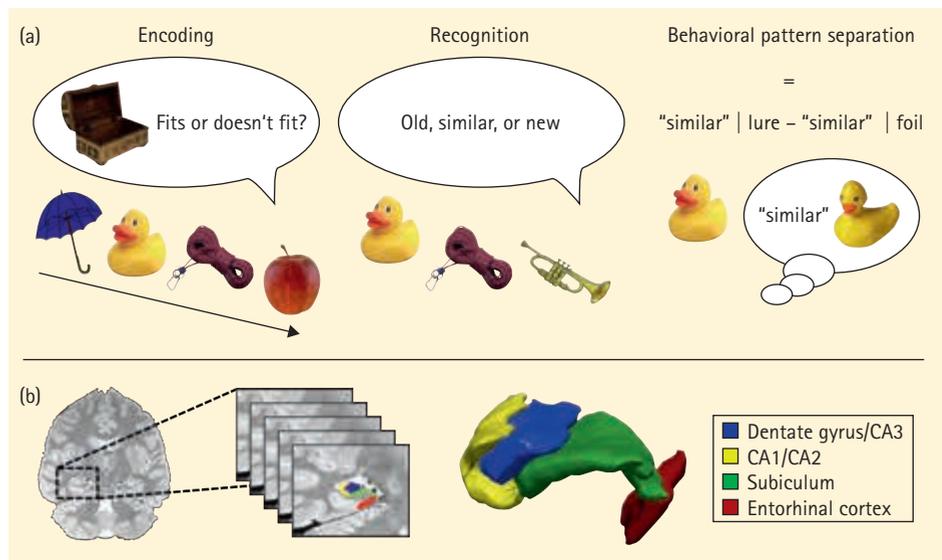


Figure 6. High-resolution structural MR images were acquired to study the contributions of maturational changes in hippocampal subregions to memory development. Trained raters manually identified boundaries between subfields. By combining subfield boundaries along the long axis of the HC, volumes were estimated based on three-dimensional models (shown on the right for the four traced subregions).

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### Age Differences in the Influence of Prior Knowledge on Memory

Prior knowledge influences memory functioning (Dissertation Garvin Brod). We showed that knowledge improves memory by facilitating binding in the HC and enhancing its communication with the association cortices (Brod, Lindenberger, Wagner, & Shing, 2016). To disentangle knowledge accessibility from availability, we developed a paradigm that induces equal amounts of artificial knowledge in younger adults and children. We showed that the medial versus lateral prefrontal cortices support successful retrieval of information that is congruent versus incongruent with prior knowledge, respectively (Brod, Lindenberger, Werkle-Bergner, & Shing, 2015). Furthermore, children aged 8 to 12 years showed less medial prefrontal, but similar HC activation as younger adults when retrieving information successfully (Brod, Lindenberger, & Shing, 2016). This is in line with the two-component model of episodic memory development (Shing et al., 2010) proposing a developmental shift from HC-bound processing to increasing recruitment of prefrontal cortex in the service of memory.

### Age Differences in the Interplay of Attention and Memory

Memory is tightly modulated by attention. However, the contributions of age differences in attention to memory are not well understood. The modulation of attention is linked to the functionality of the noradrenergic system as well as rhythmic neural activity in the alpha frequency range. To reveal their interplay and alterations with advancing age, we conducted a multimodal assessment (Dissertation Martin J. Dahl) of the structural and functional integrity of the central noradrenergic system (via neuromelanin-sensitive

MRI and pupillometry respectively) and of rhythmic neural activity (via simultaneous EEG). Our ultimate aim is to derive a mechanistic understanding of age-related declines in attention by revealing the interplay between the noradrenergic system and rhythmic neural activity within persons. This study is conducted in collaboration with Mara Mather (University of Southern California, USA).

### Extending the Toolbox of Developmental Memory Research

Cognitive neuroscience aims to establish general laws that validly describe the multiple mappings between neural processes and behavior for any individual. The heterogeneity of these mappings within and across individuals poses methodological and conceptual problems, which are exacerbated by lifespan changes in neural resources and behavioral repertoires.

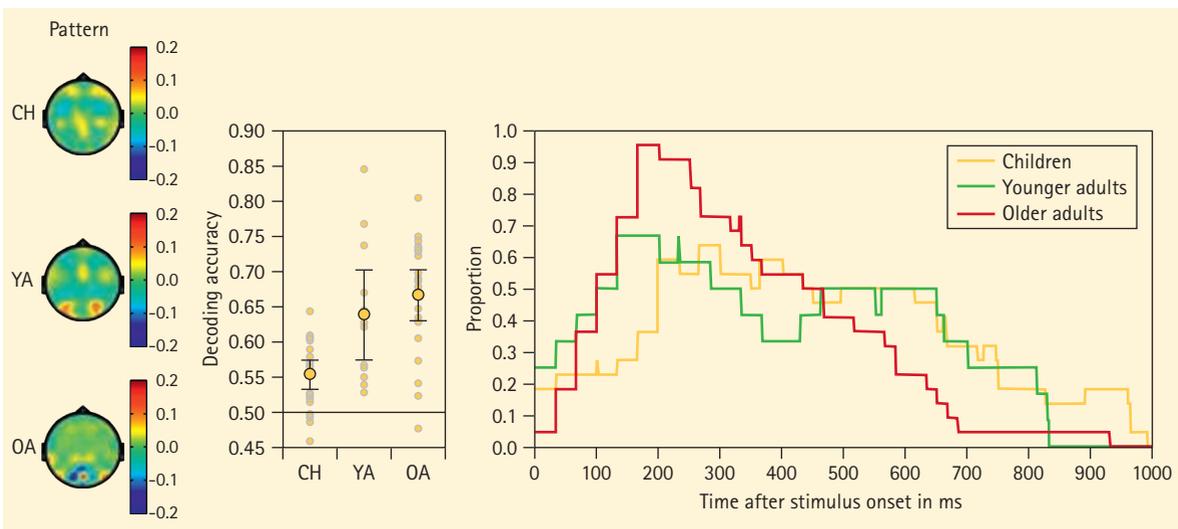
So far, between-person differences are often treated as "noise" that can be suppressed by averaging across persons. However, if individuals deviate from the "mean model" in significant ways, inferences derived from group studies may be misguided. As a principled alternative, we attempt to reliably identify neural and behavioral processing parameters at the within-person level. To this end, we explored the potential of massively repeated assessments (Dissertation Thomas H. Grandy) in conjunction with advanced statistical pattern recognition techniques (see Figure 7; cf. Karch, Sander, von Oertzen, Brandmaier, & Werkle-Bergner, 2015) to estimate person-specific parameters of processing dynamics as a viable and sound basis for generalizations across persons. This line of research is pursued in close collaboration with the *Formal Methods* project (see pp. 172–174).

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**Karch, J. D., Sander, M. C., von Oertzen, T., Brandmaier, A. M., & Werkle-Bergner, M.** (2015). Using within-subject pattern classification to understand lifespan age differences in oscillatory mechanisms of working memory selection and maintenance. *NeuroImage*, *118*, 538–552. doi:10.1016/j.neuroimage.2015.04.038



**Figure 7.** The current focus of spatial attention can be decoded with good precision from rhythmic neural EEG activity in the alpha frequency range (~10 Hz) in children, younger, and older adults. The sources of neural activity used for classification differ across age groups, as illustrated in the topographical distributions on the left. Decoding accuracy is lowest in children, but comparably high in younger and older adults, possibly suggesting higher consistency of task-based neural patterns in adults (middle graph). Inspection of the onset time points and the duration of time frames related to each participant's best classification accuracy reveals differences in the temporal emergence of discriminatory neural activity (graph to the right). High decoding accuracy for children and adults can be achieved across the entire poststimulus period. In older adults, activity specific to attentional focus is mainly found early on after stimulus onset, most likely reflecting a greater reliance on bottom-up processing (adapted from Karch, Sander, von Oertzen, Brandmeier, & Werkle-Bergner, 2015).

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### Minerva Group (led by Yee Lee Shing)

#### *Delineating Environmental Effects on Brain and Cognitive Development*

The overarching goal of this group is to better understand the mechanisms through which environmental factors, such as school entry and stress-related social disadvantage, may affect neural and behavioral development. The *HippoKID Study* longitudinally followed children born close to the cut-off date for school entry who subsequently did or did not enter school that year. Schoolchildren displayed larger behavioral improvements in cognitive control than kindergarteners and also showed increased activation in posterior parietal cortex, a region important for sustained attention, while performing an inhibitory control task (Brod, Bunge, & Shing, 2017). In contrast, longitudinally observed improvements in episodic memory did not differ reliably between the two groups, suggesting that formal school entry primarily promotes brain mechanisms that help children to focus on cognitively demanding tasks. The ongoing longitudinal *Jacobs Study* aims to elucidate the roles of glucocorticoid and inflammation signaling in mediating the effects of stress on neural and behavioral development while assessing moderators at multiple levels, including (epi-)genetic dispositions (Dissertation Laurel Raffington).

Box 1.

### Minerva Group (led by Myriam C. Sander)

#### *Age Differences in Memory Representations*

Established in 2016, this research group aims at understanding how aging affects memory representations and performance. Memories are encoded in distributed patterns of neural activity that are reactivated during later recall. To promote accurate retrieval, patterns representing different memories should differ from one another, whereas patterns representing several instances of the same memory should be similar to each other. To render memories durable, newly encoded patterns are spontaneously reactivated and strengthened during rest and sleep periods. The group will investigate how normal aging affects the distinctiveness and similarity of memory representations during memory formation and retrieval (Dissertation Verena R. Sommer). A related line of research will target age differences in the spontaneous reactivation of memories during rest.

Box 2.

## Research Project 2: Mechanisms and Sequential Progression of Plasticity

This project addresses the questions of *whether and how* plasticity contributes to adult development. Special attention is given to the relationship between neural and behavioral manifestations of plasticity. Simone Kühn was the main principal investigator of this project from 2013. She was awarded a Heisenberg Professorship (W3) at the University Medical Center Hamburg-Eppendorf (UKE), where she is continuing her work from 2017 onward. In October 2016, Yana Fandakova and Elisabeth Wenger became the co-heads of this project.

The human brain has a significant capacity to adapt to changing environmental demands by altering its function and structure (see Lövdén, Wenger, Mårtensson, Lindenberger, & Bäckman, 2013). The central goals of this project are to delineate the *mechanisms and sequential progression* of behavioral and neural plasticity across the lifespan. The guiding propositions of the project are based on the assumption that plasticity is induced by a mismatch between environmental demands and an individual's current behavioral and neural resources (see Figure 4, p. 145). The project is interested in plastic changes across the lifespan, induced by mismatches in either direction: It examines situations in which current demands exceed supply (e.g., cognitive interventions) as well as situations in which supply exceeds current demands (e.g., sensory deprivation). Training studies targeting specific brain regions and circuits that hypothetically support particular skills are central to the project's research agenda. In addition, the project also examines plasticity in real-life contexts that are likely to induce a mismatch between demand and capacity. Furthermore, examining individuals who are experts in particular skills offers yet another window on the consequences and correlates of plasticity. In the following, we provide a selective summary of completed studies, ongoing work, and future plans.

### Skilled Motor Performance

Skilled motor performance provides a rich testing ground for exploration of the mechanisms and progression of plasticity. We acquired up to 18 structural magnetic resonance (MR) images over a 7-week period while 15 right-handed participants practiced left-hand writing and drawing (Wenger et al., 2017). After 4 weeks, we observed increases in gray matter in both left and right primary

motor cortices relative to a control group; another 3 weeks later, these differences were no longer reliable (see Figure 8). Time-series analyses showed that gray matter in both primary motor cortices expanded during the first 4 weeks and then partially renormalized, in particular in the right hemisphere, in the presence of continued practice and increasing task proficiency. The regions of observed structural change are in close vicinity to anatomical hand knobs that are easily discernible on anatomical MR images and also lie within regions of functional activation maps for left- and right-hand finger tapping and left- and right-hand writing inside the scanner.

### Spatial Navigation

Following up on a series of studies investigating the influence of spatial navigation training on brain structure, we have reported gray matter increases in the right prefrontal cortex, the right hippocampal formation, and in both hemispheres of the cerebellum after daily playing of a commercially available video game in which participants had to navigate an avatar through a 3D world (Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2014). An ongoing study examines scientists who are spending 15 months at the Neumayer Station of the Centre of German Research in Antarctica. Before the scientists leave for their extended stay in an environment that is generally devoid of spatial cues, we assess their spatial abilities and acquire high-resolution structural images of the hippocampus. MR imaging assessment is repeated after the scientists return from Antarctica to examine whether the spatially poor environment in Antarctica is associated with declines in spatial abilities and related brain structures, and whether these declines are reversible. Data acquisition of two cohorts of participants is now

## Researchers

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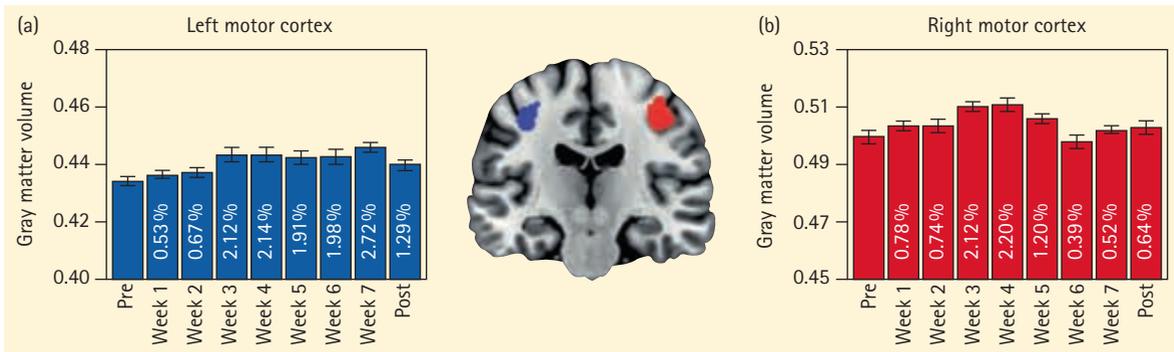
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Neda Khosravani  
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**Figure 8.** Left-hand motor training is accompanied by gray matter changes in left and right motor cortex. Individuals training fine motor skills of writing and drawing with their nondominant left hand displayed an initial expansion of gray matter volume in primary motor cortices, followed by partial renormalization, despite continued practice and increasing task proficiency. Percentages denote volume increases as compared to pretraining volume (adapted from Wenger et al., 2017).

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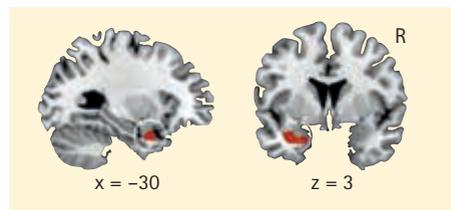
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**Lisofsky, N., Riediger, M., Gallinat, J., Lindenberger, U., & Kühn, S.** (2016). Hormonal contraceptive use is associated with neural and affective changes in healthy young women. *NeuroImage, 134*, 597–606. doi:10.1016/j.neuroimage.2016.04.042

completed, and initial results show decreases in dentate gyrus volume of the hippocampus.

### Hormonal Influences on Brain Plasticity

The brain is subject to hormonal influences, which may affect plasticity. Hence, the project has investigated the influence of gonadal hormones, in particular estrogen and progesterone, on brain structure and function in women (Dissertation Nina Lisofsky). To explore the existence of structural changes, we scanned participants at four time points distributed across the menstrual cycle. We observed a bilateral increase in posterior hippocampal volumes during the late follicular phase when estrogen is at its peak, relative to the early follicular phase when estrogen is low (Lisofsky, Lindenberger, & Kühn, 2015). A second study explored the effects of hormonal contraceptive use on brain structure. We found a decrease in gray matter in left amygdala extending into parahippocampal gyrus in women who used hormonal contraceptives (Lisofsky, Riediger, Gallinat, Lindenberger, & Kühn, 2016; see Figure 9). In a third study, we focused on the effects of pregnancy on brain and behavior. When comparing peripartal women with age-matched controls, we observed that pregnant women had lower performance in an egocentric navigation condition (associated with striatal integrity), but did not differ in an allocentric navigation condition associated with hippocampus integrity. In line with this behavioral difference, we found smaller left



**Figure 9.** Hormonal contraceptive use has an effect on brain structure. In a longitudinal study, gray matter volume in left amygdala extending into parahippocampal gyrus was found to be reduced in women who used hormonal contraceptives (adapted from Lisofsky, Riediger, Gallinat, Lindenberger, & Kühn, 2016).

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striatal volumes in peripartal women (Lisofsky, Wiener et al., 2016).

### Effects of Stress on the Brain

In collaboration with Jürgen Gallinat from Charité Universitätsmedizin Berlin and with Peter Zimmermann and Gerd Willmund from the Bundeswehr Krankenhaus Berlin, we investigated plasticity in response to traumatic and stressful events as well as the development of posttraumatic stress disorder (PTSD) (Dissertation Oisín Butler). Soldiers being deployed to areas such as Afghanistan, Mali, and Kosovo were assessed before and after their mission on a range of psychological and brain imaging measures. A specific aim of the study is to find out whether differences in hippocampal structure or function are a risk factor for stress and trauma or rather a consequence thereof (Butler et al., 2017; see Figure 10).

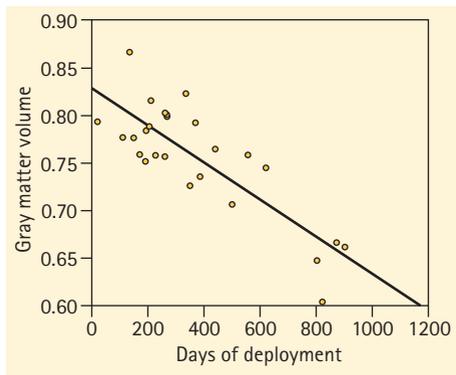


Figure 10. Military deployment correlates with smaller prefrontal gray matter volume and psychological symptoms. Longer military deployment is associated with smaller regional brain volumes in combat-exposed individuals. PTSD = posttraumatic stress disorder (adapted from Butler et al., 2017).

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### Music and the Brain

Musical expertise is another suitable model for investigating structural plasticity of sensory processing in humans. In this ongoing line of work, we target the domain of auditory processing and investigate experience-induced changes in pitch processing. We recruited young adults who had signed up for a course that prepares candidates for the music conservatory entrance examination. An important component of this training course is relative pitch discrimination, that is, the ability to identify tones and intervals in relation to a reference tone. As a control group, we recruited younger adults who had received musical training in their youth and also performed music actively in their daily lives, but did not enroll in a preparatory course. All participants were assessed behaviorally and with functional and structural MRI 4 to 5 times in 10 to 12 months. In preliminary analyses, we found that aspiring professionals, but not amateurs, show a longitudinal gray matter decrease in left superior temporal gyrus.

### Brain Structure and Metacognition

In a separate line of research, Elisa Filevich and colleagues have been investigating the association between brain structure and higher-order cognitive functions. Here, the project is particularly interested in meta-

cognition, or the ability to know what one knows, and how this knowledge is related to introspection and interoception. In this context, we examined lucid dreamers as putative experts, as these individuals appear to be aware while dreaming (Filevich, Dresler, Brick, & Kühn, 2015). We assume that metacognition matters to plasticity by contributing to the demand–capacity mismatch representation that triggers a plastic response.

### Berlin Aging Study II (BASE-II): Magnetic Resonance Imaging

In addition to the core data acquisition of the Berlin Aging Study II (BASE-II; see the *Berlin Aging Studies* project, pp. 160–162), we acquired MRI data of 345 older and 100 younger participants in 2013 and 2014 in collaboration with Sandra Düzel. A first set of publications based on these data has been submitted. In 2015/16, participants were reinvited to complete a cognitive test battery and brain imaging measures. In early 2017, two waves of imaging data were available for 227 older and 60 younger BASE-II participants.

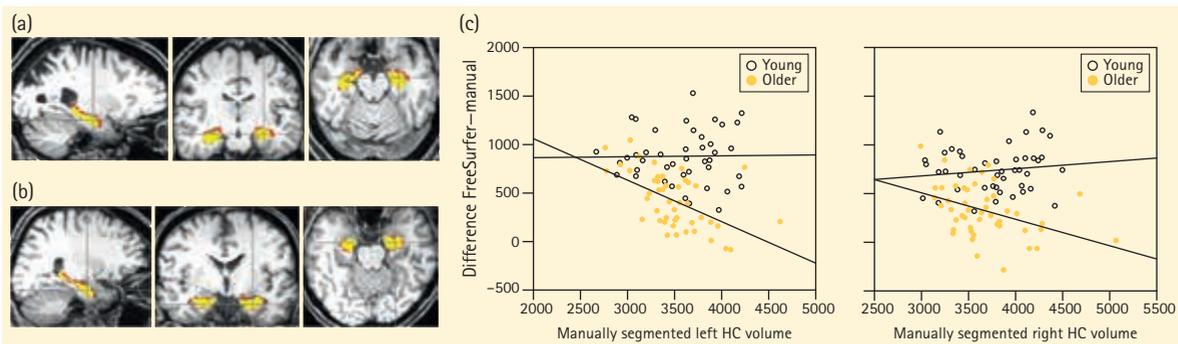
### Further Collaborations

Together with Torsten Schubert from Humboldt-Universität zu Berlin and Jürgen Gallinat from Charité Universitätsmedizin Berlin, we compared simultaneous interpreters with consecutive ones and with translators to delineate the functional and structural neural correlates of dual-task performance (Becker, Schubert, Strobach, Gallinat, & Kühn, 2016; Strobach, Becker, Schubert, & Kühn, 2015). In an additional project, we conducted a dual-task working-memory training study (Salminen, Kühn, Frensch, & Schubert, 2016; Salminen, Mårtensson, Schubert, & Kühn, 2016).

In collaboration with Martin Dresler from the MPI for Psychiatry, Munich, Dimitris Repantis from Charité Universitätsmedizin Berlin, and Kathrin Ohla from the German Institute of Human Nutrition, Potsdam, we directly compared cognitive and neural changes in response to various substances or interventions, such as glucose, caffeine, methylphenidate, modafinil, caffeine pills, and memory training (e.g., Kunath et al., 2016; Ullrich et al., 2015).

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**Figure 11.** The automatic segmentation tool FreeSurfer generally overestimates hippocampal volumes in comparison to manual segmentation, the “gold standard” method. Panels (a) and (b) show visualizations of (a) a smaller and (b) a larger manually segmented volume of the hippocampus in older adults (in yellow) and the additional voxels also labeled as hippocampal volume by FreeSurfer (in red). Critically, FreeSurfer overestimates larger hippocampal volumes in older adults (b) to a lesser extent than smaller hippocampal volumes (a), thereby introducing a bias in this age group (c) (adapted from Wenger et al., 2014).

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### Methodological Work

In close collaboration with the *Brain Imaging Methods* project (see pp. 169–171), we also conducted methodological work to better understand, calibrate, and refine MRI protocols. We critically evaluated the automatic segmentation tool FreeSurfer, which is commonly used to assess structural differences and changes of the hippocampus. We found that the properties of this tool vary by age group. In comparison to manual segmentation, FreeSurfer introduced a systematic age bias in the data, rendering its use in old age groups dubious (Wenger et al., 2014; see Figure 11). Typical MRI studies generally assume that brain structure and function are inherently stable unless an experimental intervention is applied. However, the stability of MR measures cannot simply be assumed, but must be empirically tested. Therefore, we have taken measures of brain structure and function on a day-to-day basis within the same individuals to explore whether daily fluctuations in brain imaging parameters are related to fluctuations in physiological and affective states. Initial results from this study are currently under review.

### Future Plans

#### *Language Learning and Physical Exercise to Promote Healthy Aging*

Physical and cognitive inactivity are important risk factors for age-associated cognitive decline in later adulthood, not only in neuro-

degenerative diseases but also in the normal (nonpathological) range of functioning. In recent years, it has been shown repeatedly that the structure of an adult brain can change in response to altered environmental demands. So far, however, little is known about the extent to which adoption of a physically and cognitively more active lifestyle in old age can positively influence brain structure and behavior. In a new intervention study with 160 healthy older participants, we are investigating whether the combination of cognitive and physical training boosts cognition and triggers plastic structural changes in healthy older adults more effectively than either type of training alone.

#### *Mechanisms and Progression of Plasticity in Childhood*

In a new line of research that started at the end of 2016, the project has begun to examine plasticity mechanisms in the context of child development. Childhood is characterized by maturational changes in brain structure and function and in the organization of behavior. We plan to explore age-graded and individual differences in plasticity resulting from intensive practice in task-set switching (Dissertation Neda Khosravani, in collaboration with Silvia Bunge, University of California, Berkeley, USA). With this line of research, we also seek to extend the observation of the temporal progression of behavioral and neural manifestations of plasticity to childhood and adolescence.

## Research Project 3: Intra–Person Dynamics Across the Lifespan

The overarching objective of this project is to test theories and explore research designs that articulate human development across different timescales, levels of analysis, and functional domains. The project is based on the premise that a comprehensive understanding of behavioral development across the lifespan requires a person-oriented, multivariate, and longitudinal approach. Only a high density of observations within individuals allows researchers to distinguish among different forms and functions of variability and change, with the goal of delineating the dynamic properties of human behavior (e.g., flexibility, plasticity, fluctuation, and adaptability). Such high-density data offer great opportunities for discovery and hypothesis testing but also pose new theoretical and methodological challenges. The project meets these challenges by a strong emphasis on *methodology*, understood as the productive interplay between substantive research and method development. Regarding the latter, the project collaborates closely with the *Formal Methods* project (pp. 172–174). During the reporting period, the project focused on three domains of inquiry, summarized below.

### Relationships Between Intraindividual Variability and Change Across Different Domains and Timescales

Investigations with data from the COGITO study (see Box 3) address intraindividual variability and change at timescales that range from moment-to-moment variability in reaction times, day-to-day fluctuations in cognitive performance, to changes over years—like the long-term effects of COGITO’s extensive cognitive training on cognitive abilities (Schmiedek, Lövdén, & Lindenberger, 2014b) and personality traits (Sander, Schmiedek, Brose, Wagner, & Specht, 2016). Analyses focus on the ways in which constructs are linked within persons over time, such as couplings between day-to-day fluctuations in positive affect and working-memory performance (Brose, Lövdén, & Schmiedek, 2014).

Special emphasis is placed upon attempts to explain individual differences in long-term change by individual differences in shorter-term dynamics. For example, Hertzog, Lövdén, Lindenberger, and Schmiedek (in press) found that changes in performance on a paired-associates test of episodic memory from pretest to posttest were related to changes in strategy use during the training period. Self-reports on participants’ use of memory strategies at each of the 100 daily occasions showed that memory performance increased on occasions when such strategies were actually used. Persistent individual differences in the strength of these within-person couplings,

which characterize the effectiveness of strategy use, predicted individual differences in performance gains.

Another example concerns the persistence of negative affect, often referred to as affective inertia (Brose, Schmiedek, Koval, & Kuppens, 2015), which is known to relate to depressive symptoms. Using COGITO data, we examined whether inertia is uniquely related to depressive symptoms after controlling for rumination. The consideration of rumination is highly relevant in this context because it is related to inertia and also plays an explanatory role in the etiology of depression. We used data from younger adults ( $N = 101$ ) who provided ratings of affect and rumination for 100 days. Depressive symptoms were reported before and after the study. We found that day-to-day emotional inertia is indeed related to depressive symptoms beyond rumination. Moreover, inertia predicted changes in depressive symptoms from before to after the study even after controlling for its association with rumination, thereby establishing the independent relevance of emotional inertia for longer-term change in depressive symptoms.

### Using Continuous Time and Moderated Time–Series Models to Analyze Human Development Across Different Timescales and Contexts

While most psychological processes develop continuously over time, we need to rely on discrete measurement occasions to infer them. The goal is thus to reconstruct the mecha-

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Florian Schmiedek

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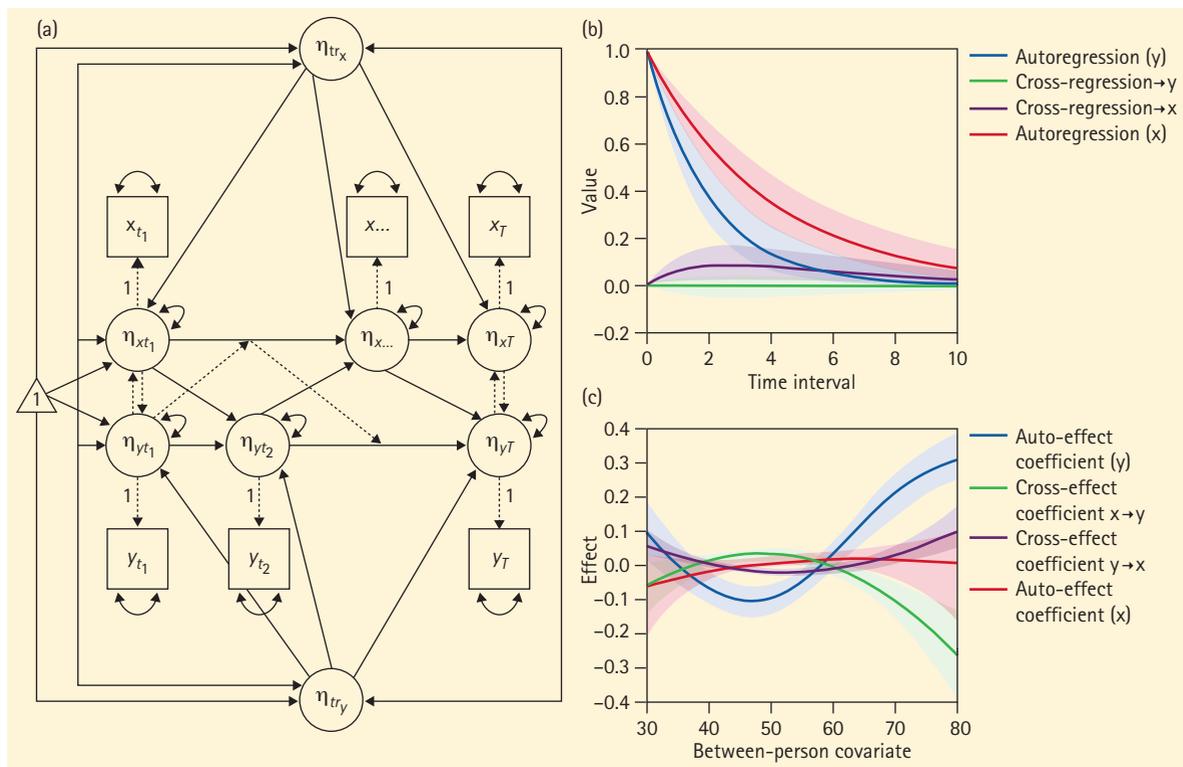
Hertzog, C., Lövdén, M., Lindenberger, U., & Schmiedek, F. (in press). Age differences in coupling of intraindividual variability in mnemonic strategies and practice-related associative recall improvements. *Psychology and Aging*.

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nisms underlying a continuously unfolding process, such as human development, based on few discrete snapshots in time. In previous work, we have argued that continuous-time models are well suited to achieve this goal. As illustrated in Figure 12 and in contrast to popular *discrete-time* methods, *continuous-time* models link discrete-time observations to underlying continuous-time parameters by stochastic differential equations. This may not only remove bias due to variability in sampling time and improve comparability across different research designs; but it also yields valuable information about the nature of change. During the reporting period, we have continued this line of research and developed *ctsem*, an R package for continuous-time

modeling that is freely available on the comprehensive R archive network CRAN (Driver, Oud, & Voelkle, 2017). In addition, we have developed a moderated time-series approach to incorporate context variables in traditional time-series models. Applying this approach to COGITO data, we are investigating changes in the dynamics of affect and stress, and how these depend on daily events. We plan to expand both lines of research by (i) adapting and applying the methods to different research domains, including youth development, personality development, and data from virtual environments that allow controlled environmental changes; and (ii) extending method development to higher-order continuous-time and non-Gaussian time-series models.



**Figure 12.** (a) Illustration of a bivariate continuous-time dynamic model. The model can be used to assess within-person dynamics on latent variables and, in this sense, is conceptually similar to autoregressive cross-lagged and bivariate latent change score models. However, the model uses stochastic differential equations to account for unequally spaced time intervals and incorporates information about heterogeneity across individuals by the inclusion of traits. Inferences on both simultaneous as well as lead-lag relationships among (latent) variables of interest are possible (see also Voelkle & Wagner, 2017). (b) In a continuous-time dynamic model, a set of continuous-time parameters are estimated, and these are combined with information about the time interval between observations to generate expected auto- and cross-regressive effects. This plot can also be understood as displaying the effects that would be expected if one had instead fit a discrete-time model, with a specific time interval between observations. (c) With the hierarchical Bayesian continuous-time dynamic models we are developing, an individual's score on some covariate or set of covariates can be used to inform and predict the individual's deviation from the population mean on all within-person parameters (such as the illustrated auto- and cross-effects).

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### Integrating Within–Person and Between–Person Information in the Search for Causal Mechanisms

Most empirical research in psychology is based on analyzing between–person variation. In contrast, most applied psychology is concerned with variation within individuals. In addition, the mechanisms specified by psychological theories generally operate within, rather than across, individuals. For example, we would like to make statements such as, “since she is so intelligent she can solve the equation,” implying that the counterfactual statement is also true. Usually, however, there is little empirical evidence for such a conclusion because what we typically observe are *other people* who are, or are not, able to solve the equation. This disconnect between research practice, applied demands, and psychological theories constitutes a major threat to the conceptual integrity of the field. Reactions range from ignoring the problem to calls for exclusively within–person research paradigms. The project is working on reconcil-

ing these extreme positions, both conceptually and methodologically. In particular, Voelkle, Brose, Schmiedek, and Lindenberger (2014) proposed the concept of *conditional equivalence* to study the commonalities of between–person and within–person structures by controlling for factors that may only affect the between–person or within–person structure. Likewise, using affect data from the COGITO study, Brose, Voelkle, Lövdén, Lindenberger, and Schmiedek (2015) showed that differences between within–person structures and between–person structures can be considered as a matter of degree. Currently, Driver and Voelkle are developing a hierarchical Bayes approach to dynamic modeling that attempts to optimally integrate information within and across individuals and time points in the context of continuous-time modeling. Our future work will continue in this direction, with an increasing emphasis on how to extract *causal* mechanisms from mixed between–person and within–person data structures.

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In October 2016, the MPI for Human Development hosted the *COGITO Conference 2016*, entitled “The COGITO Study: Looking at 100 Days Ten Years After.” Its aim was to discuss methodological and conceptual implications of the COGITO study. World-leading scientists with a strong interest and expertise in methodology, individual differences, and adult development were invited to take a fresh look at COGITO. Importantly, the COGITO data set was made available to conference participants, who were encouraged to use these data for their own analyses and publications. Five of the 29 invited conference presentations have been suggested for submission to a special section on COGITO in the journal *Multivariate Behavioral Research*.

In the COGITO study, 101 younger adults (20–31 years of age) and 103 older adults (65–80 years of age) participated in 100 daily sessions in which they worked on cognitive tasks measuring perceptual speed, episodic memory, and working memory, as well as various self-report measures (see Schmiedek, Lövdén, & Lindenberger, 2010). All participants completed pretests and posttests with baseline measures of cognitive abilities and transfer tasks for the practiced abilities. Brain-related measures were taken from subsamples of the group, including structural magnetic resonance imaging (MRI), functional MRI, and electroencephalographic (EEG) recordings. A central goal of the COGITO study was the comparison of between–person and within–person structures of cognitive abilities. Further, the COGITO study qualifies as a cognitive training study of unusually high dosage and long duration because of its 100 sessions of challenging cognitive tasks.

Box 3.

## Researchers

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Julia Schröder

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## Research Project 4: The Berlin Aging Studies (BASE)

During the 20th century, average life expectancy nearly doubled. More and more individuals in current generations of older individuals experience additional years of life between the ages of 70 and 100+. What do these added years mean in terms of levels of functional capacity and quality of life? What are the constraints on mental and physical capacities in the last years of life? Given the heterogeneity of aging trajectories and outcomes, longitudinal studies of individual development are crucial in providing answers to these questions (cf. Voelkle, Brose, Schmiedek, & Lindenberger, 2014).

For almost three decades, members of the Center have been investigating age- and death-related changes in psychological functioning in the context of the Berlin Aging Study (BASE; Baltes & Mayer, 1999; Lindenberger, Smith, Mayer, & Baltes, 2010). The Berlin Aging Study II (BASE-II; Bertram et al., 2014) was launched in 2013 to address antecedents of healthy aging. Both BASE and BASE-II are collaborative, multidisciplinary studies that involve researchers from other institutions inside and outside Berlin. In the following, we highlight select recent developments from both studies.

### *The Berlin Aging Study (BASE)*

Longitudinal data in BASE are available for eight measurement occasions spanning more than 18 years, and mortality-related information is updated at regular intervals. Almost all of the 516 individuals who participated in the 14-session multidisciplinary assessment at the first measurement occasion about 25 years ago are no longer alive. BASE data continue to provide the basis for new original publications on individual differences in late-life development (e.g., Hilbrand, Coall, Gerstorf, & Hertwig, 2017). Similarities between BASE and BASE-II (see below) allow for a direct evaluation of cohort differences in normal aging. Specifically, we compared individuals with an average age of 75 years in the years 1990 to 1993 to individuals with the same average age in the years 2013 and 2014. The later-born cohort performed much better on a test of perceptual speed ( $d = .85$ ) and reported higher morale, less negative affect, and more positive affect than the earlier-born cohort (see Figure 13). These results demonstrate the extent to which societal change can influence the course of

normal aging within relatively short periods of time.

### *The Berlin Aging Study II (BASE-II)*

BASE-II is a multidisciplinary and multi-institutional longitudinal study capturing a wide range of different functional domains. At the first wave of measurements (T1), the sample of the study consisted of 1,600 participants aged 60 to 80 years and 600 individuals aged 20 to 35 years. Data collection for T1 was completed in 2014. In addition, eligible BASE-II participants ( $n = 445$ ) were invited for magnetic resonance imaging (MRI) of the brain. The latter subsample was reinvited to a cognitive and psychosocial follow-up including a second MRI assessment from 2015 to 2016 ( $n = 327$ ; see Figure 14). The MRI assessments of the BASE-II sample were conducted by the *Plasticity* project (see p. 155).

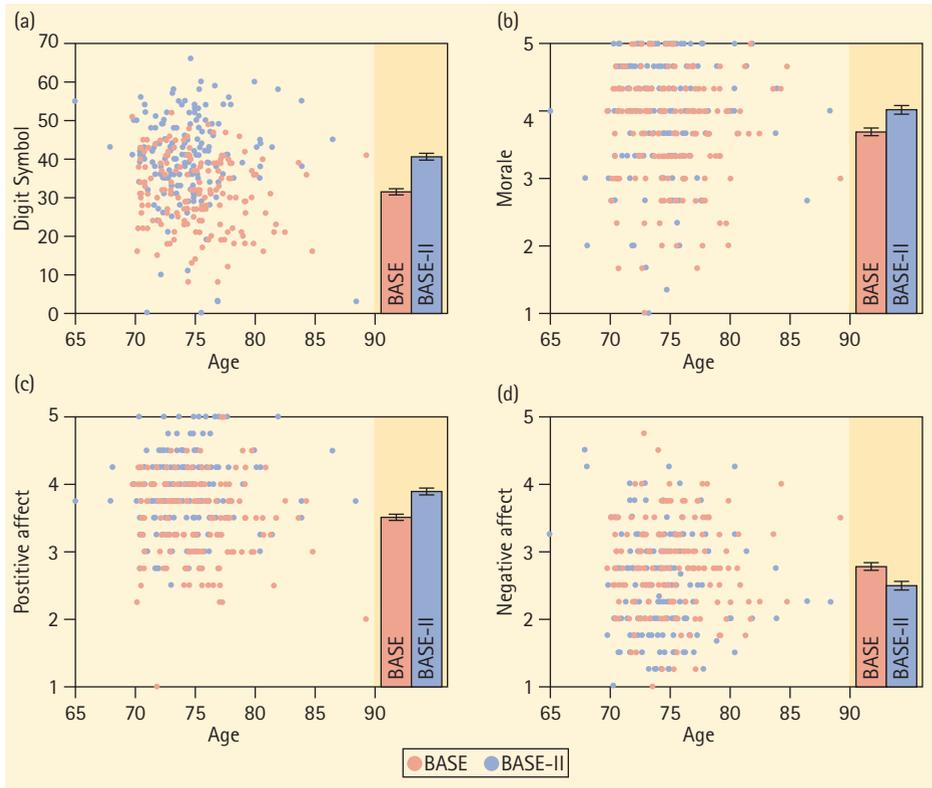
Within BASE-II, the goal of the Psychology Unit is to obtain a detailed and comprehensive picture of cognitive abilities and psychosocial characteristics. By relating individual differences in cognitive abilities and brain structure and their changes to differences in lifestyle, environmental factors, and personality, we seek to identify different patterns and psychosocial contexts of cognitive aging. Theories of motivation postulate that older individuals' subjective appraisals of their remaining life time affects their goals and activities. BASE-II researchers newly developed and validated the Subjective Health Horizon Questionnaire (SHH-Q), which reliably assesses individual differences in four distinct dimensions of future time perspective. Two of these dimensions, *Novelty* and *Body*, were found to relate differentially to cognitive status and somatic health. Specifically, greater

self-reported future novelty orientation was associated with higher current memory performance, and greater future expectations regarding bodily fitness, with better current metabolic status (Düzel et al., 2016). We expect that the SHH-Q will help to identify antecedents, correlates, and consequences of an active lifestyle.

The cognitive battery of BASE-II is well suited for investigating associations between cognition and other functional domains. Ongoing analyses investigate cross-sectional and longitudinal links to genetic variation, metabolic load, vascular risk, and psychosocial characteristics.

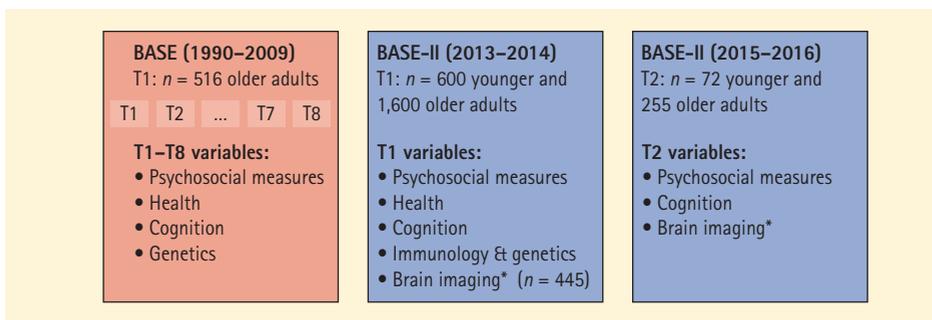
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- Gerstorff, D., Hülür, G., Drewelies, J., Eibich, P., Düzel, S., ... Wagner, G. G., & Lindenberg, U. (2015). Secular changes in late-life cognition and well-being: Towards a long bright future with a short brisk ending? *Psychology and Aging*, 30, 301–310. doi:10.1037/pag0000016



**Figure 13.** Average cohort differences and individual differences in cognitive performance (a: Digit Symbol test) and indicators of well-being (b: morale; c: positive affect; d: negative affect). The dots represent raw data from participants in the matched BASE ( $n = 161$ ; red dots) and BASE-II ( $n = 161$ , blue dots) samples. Sample means and standard errors for each cohort are displayed separately. Participants in the BASE-II cohort (data obtained from 2013 to 2014) showed higher levels of cognitive performance and well-being compared to the BASE cohort (data obtained from 1990 to 1993). The analyses suggest substantial secular improvements in cognition and well-being (adapted from Gerstorff et al., 2015).

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**Figure 14.** Schema of BASE and BASE-II study designs. \*The brain imaging assessment of BASE-II participants was conducted by the *Plasticity* project (see p. 155).

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## Overview of the Berlin Aging Study (BASE)

[www.base-berlin.mpg.de](http://www.base-berlin.mpg.de)

The multidisciplinary Berlin Aging Study (BASE), initially directed by the late Paul B. Baltes and Karl Ulrich Mayer, was started in 1989. Ulman Lindenberger heads the current BASE research group. The study spans eight measurement occasions spaced over 18 years. Its distinguishing features include (1) a focus on the very old (70 to 100+ years); (2) a locally representative sample, stratified by age and sex; and (3) a broad-based interdisciplinarity (originally involving two research units from the Freie Universität Berlin, Internal Medicine and Psychiatry, and two from this Institute, Sociology and Psychology). In addition to discipline-specific topics, four integrative theoretical orientations guide the study: (1) differential aging, (2) continuity versus discontinuity of aging, (3) range and limits of plasticity and reserve capacity, and (4) aging as a systemic phenomenon.

The initial focus of BASE (1990–1993) was to obtain a heterogeneous sample, stratified by age and sex, of individuals from the western districts of Berlin aged 70 to 100+ years. A core sample of 516 men and women completed the Intensive Protocol comprising detailed measures from all four participating disciplines. Seven longitudinal follow-ups involving different depths of assessment were completed at approximately 2-yearly intervals. Details of the research design and assessment protocols can be found on the BASE website (see also Delius, Düzel, Gerstorf, & Lindenberger, 2015). The core sample formed the basis of the cross-sectional analyses reported in two monographs (see Baltes & Mayer, 1999; Lindenberger, Smith, Mayer, & Baltes, 2010). Current work in BASE uses longitudinal data to address issues such as variability and change, mortality prediction, self-related change, and genetic predictors of cognitive change.

### The Berlin Aging Study: International Research Group

Julia A. M. Delius	MPI for Human Development, Berlin, Germany
Alexandra M. Freund	University of Zurich, Switzerland
Denis Gerstorf	Humboldt-Universität zu Berlin, Germany
Paolo Ghisletta	University of Geneva, Switzerland
Christiane Hoppmann	University of British Columbia, Vancouver, Canada
Dana Kotter-Grühn	North Carolina State University, Raleigh, USA
Shu-Chen Li	Technische Universität Dresden, Germany
Ulman Lindenberger	MPI for Human Development, Berlin, Germany (Speaker)
Nilam Ram	Pennsylvania State University, University Park, USA
Jacqui Smith	University of Michigan, Ann Arbor, USA (Co-Speaker)
Ursula M. Staudinger	Columbia University, New York, USA
Elisabeth Steinhagen-Thiessen	Geriatric Research Group, Charité Universitätsmedizin Berlin, Germany
Gert G. Wagner	German Institute for Economic Research/MPI for Human Development, Berlin, Germany (Max Planck Fellow)

## Overview of the Berlin Aging Study II (BASE-II)

[www.base2.mpg.de](http://www.base2.mpg.de)

BASE-II investigates human development into old age and aims at identifying conditions and mechanisms that contribute to individual differences in cognitive, psychosocial and physical functioning (see Bertram et al., 2014; Gerstorf et al., 2016b). In doing so, it conceives of aging as a systemic phenomenon and seeks to delineate sources of heterogeneity in aging trajectories (Lindenberger, 2014). BASE-II is structured into four research units: (1) Psychology, (2) Sociology (including Economics) and Survey Methods, (3) Medicine (including Immunology), and (4) Molecular Genetics. The initial sample consists of 1,600 participants aged 60 to 80 years and 600 individuals aged 20 to 35 years. BASE-II includes molecular genetics and immunological methods and uses instruments from the German Socio-Economic Panel (SOEP), which provide information about participants' socioeconomic background, lifestyle, and living conditions.

### The Berlin Aging Study II: Steering Committee

Denis Gerstorf	Humboldt-Universität zu Berlin, Germany (Speaker)
Lars Bertram	University of Lübeck, Germany
Ulman Lindenberger	MPI for Human Development, Berlin, Germany
Elisabeth Steinhagen-Thiessen	Geriatric Research Group, Charité Universitätsmedizin Berlin, Germany
Graham Pawelec	University of Tübingen, Germany
Gert G. Wagner	German Institute for Economic Research/MPI for Human Development, Berlin, Germany (Max Planck Fellow)

### Coordination

Katrin Schaar	MPI for Human Development, Berlin (until 12/2015), Humboldt-Universität zu Berlin, Germany (as of 01/2016)
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**Müller, V., & Lindenberger, U. (2014).** Hyper-brain networks support romantic kissing in humans. *PLoS ONE*, 9(11):e112080. doi:10.1371/journal.pone.0112080

**Szymanski, C., Pesquita, A., Brennan, A. A., Perdakis, D., ... Brick, T. R., ... Müller, V., & Lindenberger, U. (2017).** Teams on the same wavelength perform better: Inter-brain phase synchronization constitutes a neural substrate for social facilitation. *NeuroImage*, 152, 425–436. doi:10.1016/j.neuroimage.2017.03.013



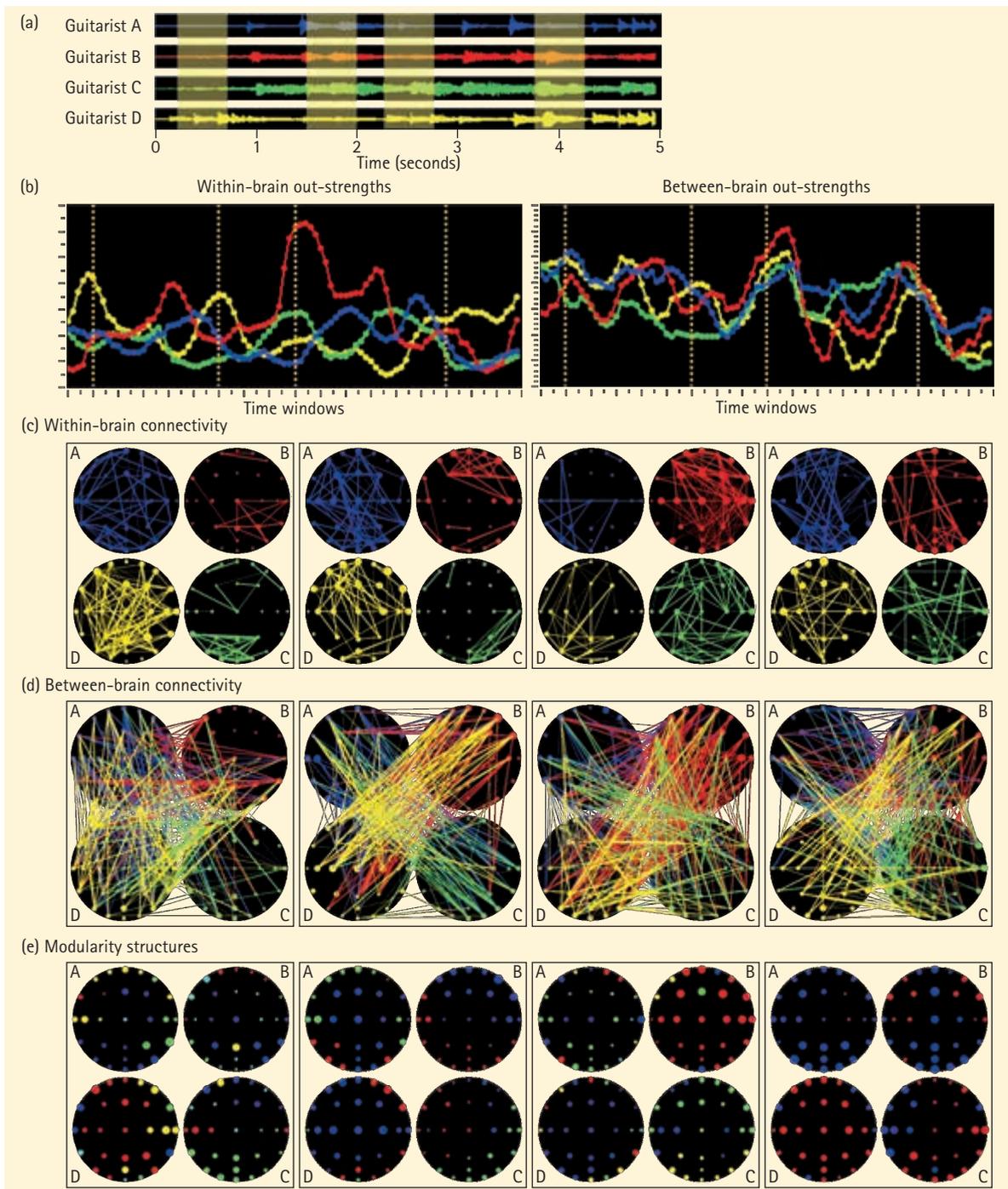
**Figure 16.** To identify the neural correlates of interpersonal action coordination, the *Interactive Brains, Social Minds* project recorded the EEG of musicians playing together under a variety of experimental conditions.

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our previous results on guitar duets. Furthermore, we observed evidence for hyper-brain modules that include nodes from two, three, or even four brains (see Figure 17). In a methodologically oriented reanalysis of standard single-person EEG data during rest and auditory oddball performance (Müller et al., 2016), we showed that *cross-frequency couplings* (CFC), in addition to *within-frequency couplings* (WFC), help to characterize the topology of *hyper-frequency networks*, including condition differences in graph-theoretical parameters, such as strength, clustering coefficient, characteristic path length, as well as local and global efficiency. We explored the utility of hyper-frequency, hyper-brain networks in a data set of couples engaged in romantic kissing (Müller & Lindenberger, 2014). Oscillations in the alpha band played a central role in binding the two brains together. Also, network strengths were higher and characteristic path lengths were shorter when individuals were kissing each other than when they were kissing their own hand. Between-brain strengths of theta oscillations (around 5 Hz) were reliably associated with reported partner-oriented kissing satisfaction, especially over frontal and central electrodes.

Given our earlier observations of fronto-central between-brain synchronization in guitar players, we suggest that these couplings reflect cell assemblies representing movement coordination among interacting partners. During the reporting period, we also went back to cardiac, respiratory, and vocalizing data from 11 singers and 1 conductor engaged in choir singing (Müller & Lindenberger, 2011). Ongoing analyses reveal that cardiac, respiratory, and voice production subsystems interact among each other both within and across singers as a function of whether a canon is sung in unison or in different voices. The conductor's hand movements are synchronized with each of the three subsystems.

In a second line of work, the project has sought to devise new EEG paradigms that are suited to delineate the behavioral function of inter-brain synchrony (Dissertation Caroline Szymanski). In one of these studies (Szymanski et al., 2017), participants were asked to perform a visual search task either alone or with a partner. Local phase synchronization and between-brain phase synchronization were generally higher when partners attended to a visual search task jointly than when they attended to the same task individually. Also, between-team differences in behavioral performance gain during the joint condition were associated with between-team differences in local and inter-brain phase synchronization. These results suggest that phase synchronization constitutes a neural correlate of social facilitation and may help to explain why some teams perform better than others. A second study tests the hypothesis that same-frequency, same-phase transcranial alternating-current stimulation (tACS) is associated with greater behavioral synchrony in a dyadic drumming task than no stimulation or stimulation that differs in phase and frequency. The collected data are currently being analyzed.



**Figure 17.** Coupling strengths and connectivity brain maps while playing guitar in a quartet. (a) Guitar traces in the four guitarists and the four time windows represented by the brain maps. (b) Time course of within- and between-brain out-strengths in the four guitarists. (c) Brain maps of within-brain connectivity in the four guitarists across the four time windows shown in (a). (d) Brain maps of between-brain connectivity in the four guitarists across the same four time windows. Note that color in (a)–(d) corresponds to the different guitarists as depicted in (a). During the first time window, when guitarist D (shown in yellow) is playing alone, strong within- and between-brain connectivity is evident. (e) Modularity structures of hyper-brain networks across the same time windows. Modules are coded by color. Note that most are hyper-brain modules sharing nodes from two, three, or even four brains.

## Researchers

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Maike M. Kleemeyer

## Key Reference

Schaefer, S., Schellenbach, M., Lindenberger, U., & Woollacott, M. (2015). Walking in high-risk settings: Do older adults still prioritize gait when distracted by a cognitive task? *Experimental Brain Research*, 233, 79–88. doi:10.1007/s00221-014-4093-8

## Research Project 6: Sensorimotor–Cognitive Couplings

Goal-directed behavior requires the seamless integration of perception, movement, and thought. Examples include the simultaneous performance of cognitive and motor tasks, the coordination of elementary body movements, and action planning. The project investigates how infants construct these integration skills and how they further evolve across the lifespan.

The Movement Lab, in which most of our research takes place, is equipped with a motion capture system allowing us to measure the positions of reflective markers attached to a participant's body with high temporal and spatial accuracy (see Figure 18). Motion capture can be combined with synchronized measurements of ground reaction forces control or muscle activity. The Lab is also equipped with a multichannel video system for behavioral studies with infants.

### Coordination of Cognitive and Motor Performance in Dual-Task Situations

When a cognitive and a motor task need to be performed concurrently, older adults often show higher dual-task costs than younger adults and tend to prioritize the motor domain (Schaefer, 2014). However, we found that this prioritization may function less effectively in older relative to younger

adults when multiple challenges are combined (Schaefer, Schellenbach, Lindenberger, & Woollacott, 2015). In our study, participants walked on a speed-adaptive treadmill as fast as possible through four different virtual environments: broad or narrow tracks; on ground level or an elevated level (see Figure 19). Young adults maintained their walking speed and kept the number of missteps low, even when walking on an elevated narrow track while performing a challenging working-memory task. In contrast, older adults actually increased their walking speed on elevated relative tracks and committed more missteps under cognitive load. In the real world, this strategy may be maladaptive and result in falls. We also investigated the influence of walking speed and cognitive load on gait regularity in children aged 7 or 9 years and young adults (Schaefer, Jagenow, Verrel, & Lindenberger, 2015). In all age groups, regularity of lower body coordination increased with walking speed. Children showed a U-shaped relationship between cognitive load and walking regularity, with the highest regularity in the easy cognitive task. In contrast, young adults' gait regularity was not influenced by cognitive load. These results indicate that the effects of cognitive load on motor performance are modulated by age, similar to what we observed in an earlier study comparing younger and older adults.

### Interaction of Cognitive and Motor Task Components

Cognition and motor control also interact when cognitive tasks require a complex motor response. We investigated the influence of response conflict on movements requiring a postural preparation in form of a weight shift, namely, lifting one foot from the floor in a standing position while ignoring visual distractors priming the same or the opposite response (see Figure 20a). Under balance

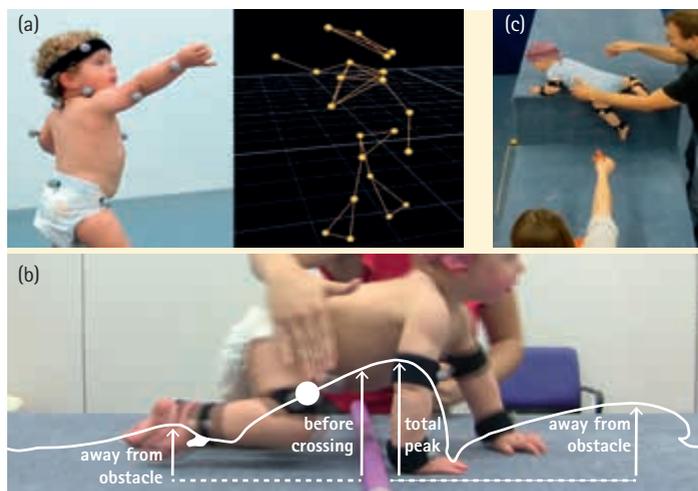


Figure 18. Experimental setups and measurements in the Movement Lab. (a) Infant equipped with reflective markers for motion capture and reconstructed 3D marker positions. (b) Infant crawling over obstacle. Anticipatory control is quantified in terms of knee clearance at the obstacle and away from the obstacle, measured by 3D motion capture. (c) Setup to investigate judgment of action possibilities and motor planning in infants. Here, the infant uses an alternative strategy (descending backward) on a step too high for him to walk or crawl down.

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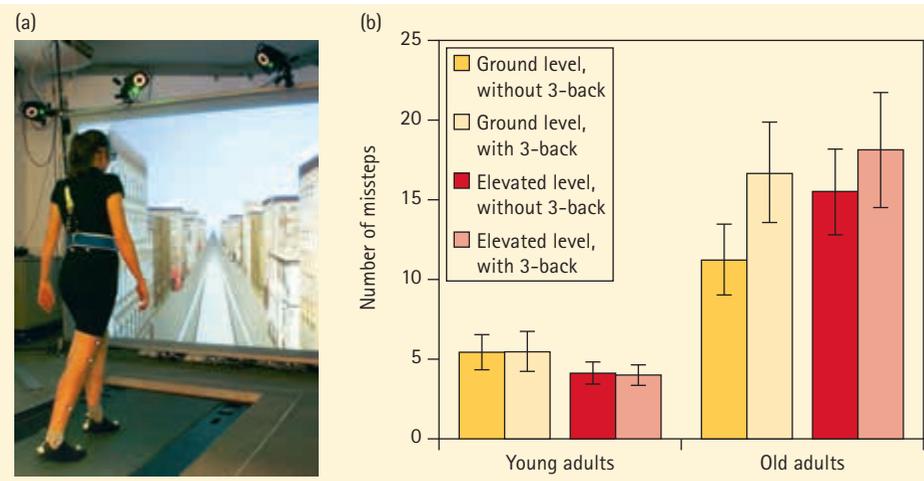


Figure 19. Coordination of cognitive and sensorimotor task demands during walking. (a) Experimental setup showing treadmill and virtual environment, walking on an elevated wide track. (b) Number of missteps on the narrow tracks on even ground and in the elevated setting with and without a concurrent working-memory task (3-back). Error bars represent the standard error of the mean (adapted from Schaefer, Schellenbach, Lindenberger, & Woollacott, 2015).

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constraints, young adults showed automatic imitation tendencies for whole-body movements (Verrel, Lisofsky, & Kühn, 2014). In a subsequent age-comparative study (Verrel, Lisofsky, Kühn, & Lindenberger, 2016), older adults responded more slowly than younger adults, whereas stimulus-compatibility effects did not differ reliably by age (see Figure 20b). Compatibility effects as well as age differences in response latency were associated with postural preparation errors, pointing to erroneous response activation as their potential source. In ongoing studies, we seek to delineate the points in the action hierarchy, from goals to movement execution, at which these compatibility effects originate.

### Movement Coordination, Anticipatory Control, and Action Planning

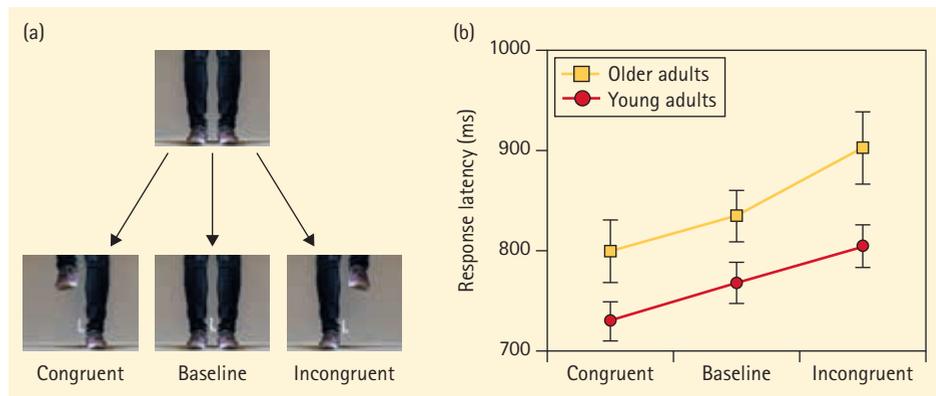
Motor behavior requires the coordination of multiple body parts to achieve desired action outcomes. We introduced a novel method that estimates interjoint coordination by quantifying the effect of artificially eliminating movement at individual joints. Applying this “freezing” method to the coordinative skill of cello bowing revealed pronounced differences between novices and expert cello players, especially for the wrist and

elbow (Verrel, Woollacott, & Lindenberger, 2014). Our results emphasize the importance of coordination across multiple joints, in particular distal joints, for skilled motor performance.

Anticipatory control and advance planning are defining features of motor action. In collaboration with Karen Adolph (New York University, USA), we have begun to investigate anticipatory adjustments to locomotor movements in young infants crawling over small obstacles (see Figure 18b). Preliminary results indicate that infants use visual and haptic information for anticipatory adjustments of locomotion. In contrast to results from animal studies, however, anticipation was found to be unstable, showing high intra- and interindividual variability. Currently, we are investigating decision making, advance planning, and motor coordination in infants aged 10 to 16 months when confronted with height challenges that vary in difficulty (see Figure 18c). In particular, we explore how flexibly and adaptively infants use alternative strategies, such as descending via a sitting posture, sideways or backward, and to what extent these strategies generalize across environmental conditions, such as steps versus slopes, and across locomotor styles, such as crawling and walking.

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**Figure 20.** Response conflict in whole-body movements with balance constraints. (a) Exemplary stimuli (Verrel, Lisofsky, & Kühn, 2014; Verrel, Lisofsky, Kühn, & Lindenberger, 2016). Participants responded to the symbolic stimulus (L or R) by lifting their left or right foot off the floor. Visual distractors showed a congruent or incongruent movement. (b) Response times for young and older adults. Postural preparation errors showed an analogous pattern, and differences in response times between conditions and age groups were largely explained by erroneous postural preparation (adapted from Verrel, Lisofsky, Kühn, & Lindenberger, 2016).

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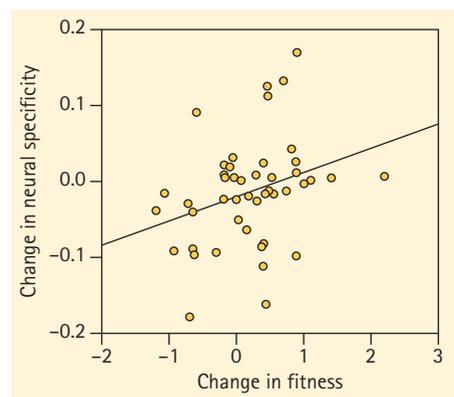
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Kleemeyer, M. M., Polk, T. A., Schaefer, S., Bodammer, N. C., Brechtel, L., & Lindenberger, U. (2017). Exercise-induced fitness changes correlate with changes in neural specificity in older adults. *Frontiers in Human Neuroscience*, *11*:123. doi:10.3389/fnhum.2017.00123

#### Effects of Physical Exercise on Brain and Behavior

In close collaboration with the *Plasticity* project (pp. 153–156), we conducted an exercise intervention study to identify physiological mechanisms that may elucidate the positive association between regular physical activity on cognitive performance in old age. Fifty-two older adults exercised on bicycle ergometers for 6 months three times a week. Changes in fitness were associated with changes in hippocampal tissue density (measured by mean diffusivity), which in turn were associated with changes in hippocampal volume. These results suggest that fitness-related changes in hippocampal volume may be driven by an increase in cell membranes (Kleemeyer et al., 2016). In addition, we found a positive association between changes in fitness and changes in the specificity of neural responses to visual stimuli (see Figure 21; Kleemeyer et al., 2017), suggesting that regular physical exercise can help maintain neural specificity in older adults. In ongoing

analyses of this data set, we examine whether changes in white matter and cerebral blood flow are associated with exercise-induced fitness changes.



**Figure 21.** Relation between physical fitness and brain function. Scatter plot displaying a significant association between changes in fitness and changes in neural specificity, that is, the degree to which neural representations of different visual stimuli (e.g., faces and houses) can be discriminated by means of multivariate pattern analysis (adapted from Kleemeyer et al., 2017).

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## Research Project 7: Brain Imaging Methods in Lifespan Psychology

Research on human development seeks to delineate the variable and invariant properties of age-graded changes in the organization of brain–behavior–environment systems. Magnetic resonance imaging (MRI) and magnetic resonance spectroscopy (MRS) have become indispensable tools in this context, as they allow noninvasive assessment of brain function, anatomy, microstructure, and metabolism.

The two main goals of the *Brain Imaging Methods* project are: (i) to ascertain and improve the measurement quality of standard brain imaging protocols at the Center; (ii) to complement the standard imaging repertoire by advanced sequences with enhanced interpretability that hold promise in elucidating structural changes and physiological mechanisms related to maturation, learning, and senescence. In pursuing these goals, the project serves as a resource to other projects interested in imaging (e.g., Kleemeyer et al., 2016; Wenger et al., 2017).

*Structural and quantitative MRI methods* occupy a central place in the project. During the reporting period, the project has focused on (i) high-resolution  $T_1$ -weighted imaging to obtain estimates of volume or thickness of specific substructures of the brain; (ii) diffusion imaging and multiparametric mapping (MPM) to obtain brain maps that permit quantitative estimates of histological parameters; (iii) susceptibility-weighted imaging to obtain maps of mineralization, especially for the brain's deep gray matter structures; and (iv) myelin water fraction (MWF) imaging by mapping the fraction of shortest  $T_2$  relaxation rates quantitatively. The latter method provides an estimate of the portion of water molecules located between myelin sheaths, presumably reflecting the degree of myelination within white matter. Work on MPM profits from collaboration with Nikolaus Weiskopf (MPI for Human Cognitive and Brain Sciences, Leipzig, Germany).

*Functional MRI and MRS* are used to provide maps and spectra of brain activity during task performance or at rest. The project takes special interest in: (i) high-resolution functional imaging of the hippocampus; (ii) task-related, time-resolved applications of proton MRS, with a focus on glutamate and GABA; and (iii) phosphorus MRI to capture individual

differences in brain metabolism. Work in this area involves collaborations with Mara Mather (University of Southern California, Los Angeles, USA), Florian Schubert (Physikalisch-Technische Bundesanstalt, Berlin, Germany), and Jeff Stanley (Wayne State University, Detroit, USA).

In the following, we provide additional details on three of the methods that have been the focus of our attention during the reporting period.

### Diffusion Imaging

Diffusion imaging captures the movement of water molecules, termed diffusion. Diffusion in tissue is hindered by cell membranes. Therefore, the orientation-dependent diffusion profiles provide information about tissue microstructure. For instance, when water molecules are observed in myelinated neuronal fibers, their diffusion is less hampered along than across fiber tracts. Diffusion within a voxel (a three-dimensional data point) is often captured by a tensor (ellipsoid) model. However, by permitting only one directional description per voxel, diffusion tensor imaging provides an impoverished, and at times inaccurate, picture of histological reality; for instance, the crossing of fibers may go unnoticed. To enhance the microstructural veridicality of diffusion imaging, the project is working on multishell diffusion imaging acquisition schemes to improve the precision of orientational information. Diffusion models under scrutiny are the sticks-and-ball model (used by FMRIB Software Library, FSL), constrained spherical deconvolution (implemented in MRtrix), and physiologically motivated multicompartiment models (e.g., neurite orientation dispersion and density imaging, NODDI). We plan to use multishell diffusion imaging in combination with nontensor diffusion modeling to move toward a more

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**Enggruber, P., & Kreis, F.** (2015). *Development of three-dimensional spectrally selective phosphorous magnetic resonance imaging for analysing metabolism in the human brain*. Master's thesis, Technische Universität Berlin.

precise picture of age- and training-related changes in the brain's structural connectivity.

### Quantitative Multi-Parameter Mapping (MPM)

Normal aging is accompanied by characteristic changes in the brain's morphology and microstructure. Quantitative MRI can help in characterizing the brain's microanatomy by using the physical properties of water that govern the MRI contrast as surrogate parameters to describe tissue properties. Nikolaus Weiskopf, Gunther Helms, and colleagues have developed a comprehensive quantitative multiparameter mapping approach, which provides high-resolution maps of the longitudinal relaxation rate ( $R_1 = 1/T_1$ ), effective proton density ( $PD^*$ ), magnetization transfer (MT), and effective transverse relaxation rate ( $R_2^* = 1/T_2^*$ ) (see Figure 22 showing exemplary maps for one subject examined in our project). In collaboration with the *Plasticity* project (pp. 153–156), we are currently investigat-

ing the reproducibility of MPM parameters within and across measurement occasions. For instance, we have acquired data from 15 volunteers, each measured four times on two consecutive days, either with or without repositioning, to tease apart various factors affecting reproducibility.

### Phosphorus MRI

The mitochondria are organelles in eukaryotic cells that provide energy for the cell's metabolism through glycolysis (i.e., the releasing of energy stored in glucose). Adenosine triphosphate (ATP) is generated during glycolysis for high-energy short-time storage. ATP concentration levels are stabilized by the creatine kinase (CK) reaction, which buffers ATP. Phosphocreatine (PCr) markedly varies with energy metabolism. Mapping changes in PCr concentration in brain tissue can thus be used to calculate an index of the brain's energy metabolism in response to short-term peaks in energy demand. During the report-

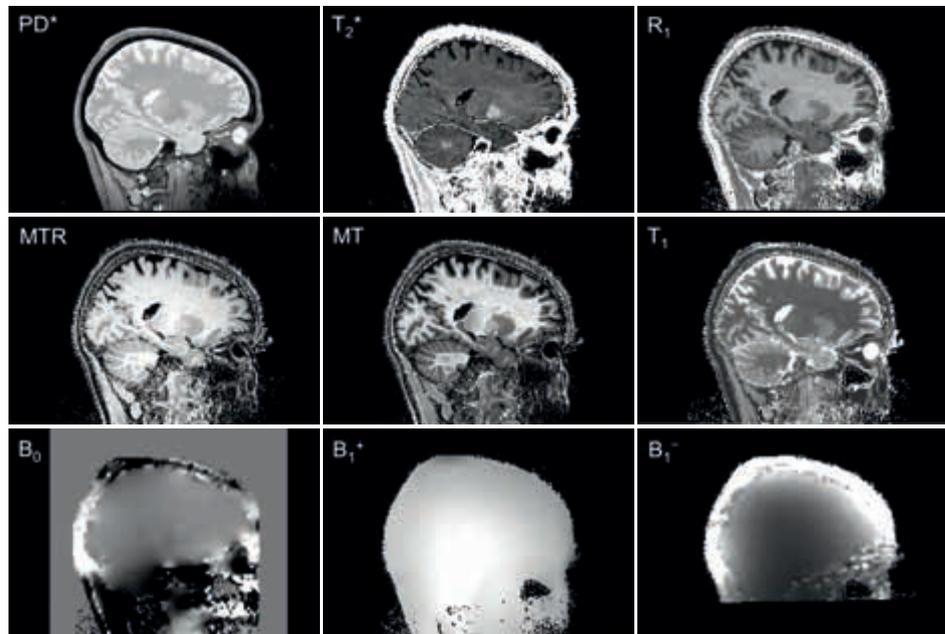


Figure 22. Sagittal slices through maps of  $PD^*$  and  $T_2^*$ ,  $R_1$ , MTR, MT, and  $T_1$ . Additionally, sagittal slices through the determined inhomogeneities of the static magnetic field ( $B_0$ ), the high-frequency transmit field ( $B_1^+$ ), and the coil-specific receive profile ( $B_1^-$ ) are presented. The information about  $B_0$ ,  $B_1^+$ , and  $B_1^-$  is used for further improvement of the accuracy of the quantitative magnetic property maps depicted above, which can be seen as being dependent on a set of tissue properties on a cellular level (e.g., the degree of myelination, axonal density, and mean water content) and thus permit assessment of gray and white matter microstructure (unpublished project data).

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ing period, the project has developed two different variants of a spectrally selective 3D turbo spin echo (TSE) imaging sequences that selectively excites PCr (Enggruber & Kreis, 2015). One sequence version allows for the functional (i.e., temporally resolved) task-related acquisition of the PCr concentration, whereas the other is designed to generate maps of the kinetic rate of the CK reaction by using selective saturation of the gamma ATP peak (see Dissertation Julian Q. Kosciessa in Lifespan Neural Dynamics Group, p. 199). In collaboration with Jeff Stanley, the project is working on establishing phosphorus MRI as a technique that may allow researchers at the Center to study individual differences in cerebral energy consumption as a function of age and other person characteristics.

### **The Magnetic Resonance Imaging Laboratory**

The Institute operates a Siemens TIM Trio tomograph, which has a field strength of 3 Tesla. The MR system is equipped for proton ( $^1\text{H}$ ) MRI and MRS with 12-channel and 32-channel head radio frequency coils, and a circularly polarized birdcage headcoil. Instrumentation for phosphorus ( $^{31}\text{P}$ ) MRS,

that is, a dual-tuned circularly polarized head coil, a dual-tuned surface coil, and an additional high-frequency amplifier working at the resonance frequency of phosphorus, is also available. Additional components include a transcranial magnetic stimulation system with an MR-suited stimulation coil; an MR-suited EEG system; an audio/video stimulus presentation system using headphones and goggles; a visual presentation system based on video projection, mirrors, and a screen; an MR-compatible eye-tracking system; and a variety of hand-held response boxes for children and adults. The laboratory also houses a mock (i.e., fake) scanner that looks and sounds just like the real scanner. The mock scanner is used to familiarize research participants, in general, and children, in particular, to the scanning environment. As of March 2017, the core MR team consists of Sonali Beckmann (head of the MRI Measurement Facility), Nils C. Bodammer (physicist), Thomas Feg (technician), Davide Santoro (physicist), Sebastian Schröder (technician), and Nadine Taube (technical assistant). The team provides scientific and technical support for all MR imaging activities at the Institute.

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Timothy R. Brick  
(until 09/2014)  
Julian D. Karch  
John J. Prindle  
(until 09/2015)

Janne Adolf  
Charles C. Driver

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**Driver, C. C., Oud, J. H. L., & Voelkle, M. C.** (2017). Continuous time structural equation modeling with R package *ctsem*. *Journal of Statistical Software*, 77:5. doi:10.18637/jss.v077.i05

**Karch, J. D., Sander, M. C., von Oertzen, T., Brandmaier, A. M., & Werkle-Bergner, M.** (2015). Using within-subject pattern classification to understand lifespan age differences in oscillatory mechanisms of working memory selection and maintenance. *NeuroImage*, 118, 538–552. doi:10.1016/j.neuroimage.2015.04.038

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## Research Project 8: Formal Methods in Lifespan Psychology

Since its foundation by the late Paul B. Baltes in 1981, the Center for Lifespan Psychology has sought to promote conceptual and methodological innovation within developmental psychology and in interdisciplinary context. Over the years, the critical examination of relations among theory, method, and data has evolved into a distinct feature of the Center. The temporal resolution of data relevant for lifespan research varies widely, from the millisecond range provided by behavioral and electrophysiological observations to the small number of occasions spread out across several years provided by longitudinal panel studies. The *Formal Methods* project is dedicated to developing multivariate mathematical, statistical, and computational research tools that accommodate complex research designs with multimodal assessments collected over a wide range of timescales. It seeks to provide practical solutions to the methodological challenges of lifespan research and related fields of scientific inquiry. Its main goals are to critically examine the link between theory and data and equip researchers with means to improve the efficiency of data acquisition and data analysis.

The project is particularly interested in analyzing individual differences in longitudinal change. Hence, the project has further broadened its interest in Structural Equation Modeling (SEM) methods, which integrate a wide range of different multivariate analysis techniques. During the reporting period, project members have shown how SEM as a formal language can assist researchers in: (i) optimally planning longitudinal studies under constrained resources; (ii) refining or modifying hypotheses through comprehensive exploratory data analysis; (iii) appropriately modeling unequally spaced measurements, context effects, and individual differences in longitudinal research; and (iv) modeling the emergence of individuality and its relationship to brain plasticity.

### New Methods for Analyzing Change

Longitudinal panel studies are a key empirical method to chart between-person differences in behavioral and neural development. The project members have been working on developing and evaluating new methods to analyze change. Most dynamic models (e.g., cross-lagged panel models) currently in use in psychological research assume that measurement occasions are equally spaced in time. This failure to account for unequal spacing of measurement occasions may seriously bias parameter estimates. Driver, Oud, and Voelkle (2017) have developed a software package for the estimation of continuous-time SEM, called *ctsem*. It is suited for the analysis of panel

( $N > 1$ ) and time series ( $N = 1$ ) data. By using stochastic differential equations to estimate an underlying continuous process, continuous-time models can accommodate any pattern of measurement occasions. *ctsem* can estimate relationships over time for multiple latent processes, measured by multiple noisy indicators with varying time intervals between observations. Within- and between-person effects are estimated simultaneously, and exogenous shocks of different types as well as oscillating processes can be specified.

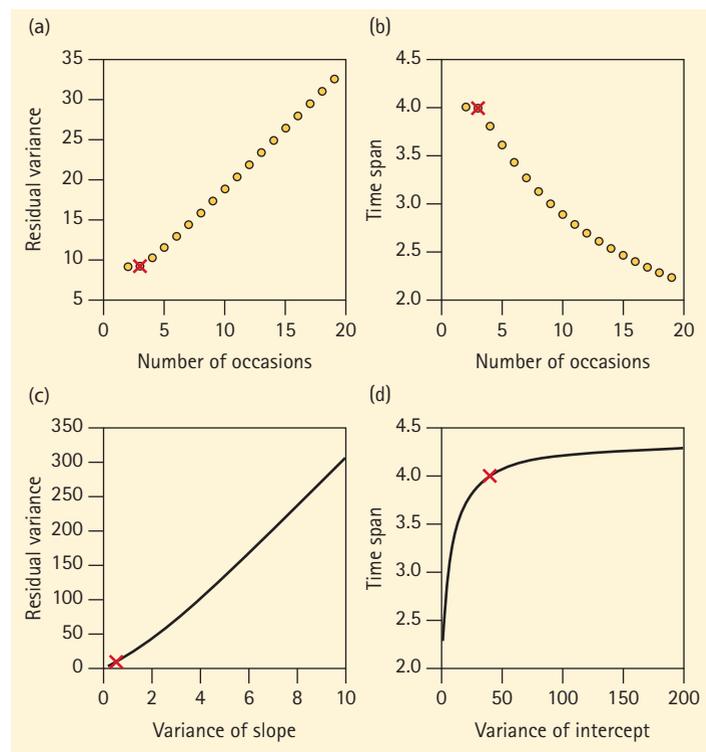
Ongoing work is concerned with a novel class of models, Gaussian process panel models (GPPM), suitable for expressing complex hypotheses about change. This class of models draws upon ideas from Gaussian process regression, a powerful and generic nonparametric regression technique in machine learning. GPPM provides a flexible specification framework that subsumes most classic analysis approaches (e.g., SEM, Generalized Linear Models, Generalized Additive Models, or State Space Models). In his dissertation, Julian D. Karch (2016) showed that GPPM also offers novel characterizations of change that cannot be formalized within the other frameworks. Similar to *ctsem*, GPPM is well suited for continuous-time modeling, allowing for unequal time lags both between measurements and across people. The empirical comparison between the GPPM toolbox for *Matlab* and existing SEM software reveals that the GPPM representation of common longitudinal SEM may decrease computation time for param-

eter estimation by up to a factor of 9. The project members have made various further contributions to making the estimation of SEM more efficient in practice. In a related project, Karch proposed a machine-learning inspired approach to better account for interindividual differences in models relating oscillatory brain activity to behavior (Karch, Sander, von Oertzen, Brandmaier, & Werkle-Bergner, 2015).

In her dissertation project, Janne Adolf investigates the application of formal models to intense longitudinal data on daily emotion experiences and behaviors, with an emphasis on dynamic models that incorporate the changing contextual conditions of emotional experiences and behaviors. Andreas M. Brandmaier and Timo von Oertzen have continued their work on  $\Omega$ nyx, a freely available software environment for creating and estimating SEM. The software offers a graphical user interface to facilitate the specification of models and includes a powerful back-end for performing parameter estimation (von Oertzen, Brandmaier, & Tsang, 2015).  $\Omega$ nyx automatically generates model syntax to interface with other software packages, for example, OpenMx, lavaan, and Mplus.

### Optimizing the Design of Longitudinal Studies

Longitudinal studies often require a large investment of resources and are often characterized by a relatively large number of individuals, a range of more or less reliable measurement instruments, and a relatively small number of measurement occasions. When applied to the measurement of change, the statistical power to detect a particular effect, that is, the probability that a statistical test will reject a false null hypothesis of no effect, is the primary indicator of change sensitivity and intuitively or explicitly informs the research design of longitudinal panel studies. Based on power equivalence theory (von Oertzen, 2010), von Oertzen and Brandmaier (2013) showed formally how design-related choices affect power and how these choices can be used to optimize the efficiency of longitudinal designs while keeping power constant. To evaluate change



**Figure 23.** Optimizing longitudinal study design with the LIFESPAN program. Researchers can inspect bivariate iso-power contours to identify latent growth curve models with different design parameters, but identical statistical power, to detect individual differences in change. The figure refers to the OCTO-Twin study; in each panel, the actual study design is marked with a cross. The panels show power tradeoff relations for: (a) number of occasions and residual variance; (b) number of occasions and total study time span; (c) variance of slope and residual variance; and (d) variance of intercept and total study time span. Lines in (c) and (d) indicate alternative study designs with equal power on a 1-df specific variance test (reprinted with permission from Brandmaier, von Oertzen, Ghisletta, Hertzog, & Lindenberger, 2015).

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sensitivity and thereby enable researchers to generate alternative, power-equivalent study designs, Brandmaier, von Oertzen, Ghisletta, Hertzog, and Lindenberger (2015) introduced LIFESPAN, a new statistical tool that allows researchers to interactively modify and optimize longitudinal study designs (see Figure 23 for an example). In ongoing work, the group is extending this framework to arrive at an integrated understanding of measures of precision, reliability, and effect size for individual differences in change.

### Brain–Behavior Relations and the Emergence of Individuality

Together with colleagues from the DFG Center for Regenerative Therapies and the German

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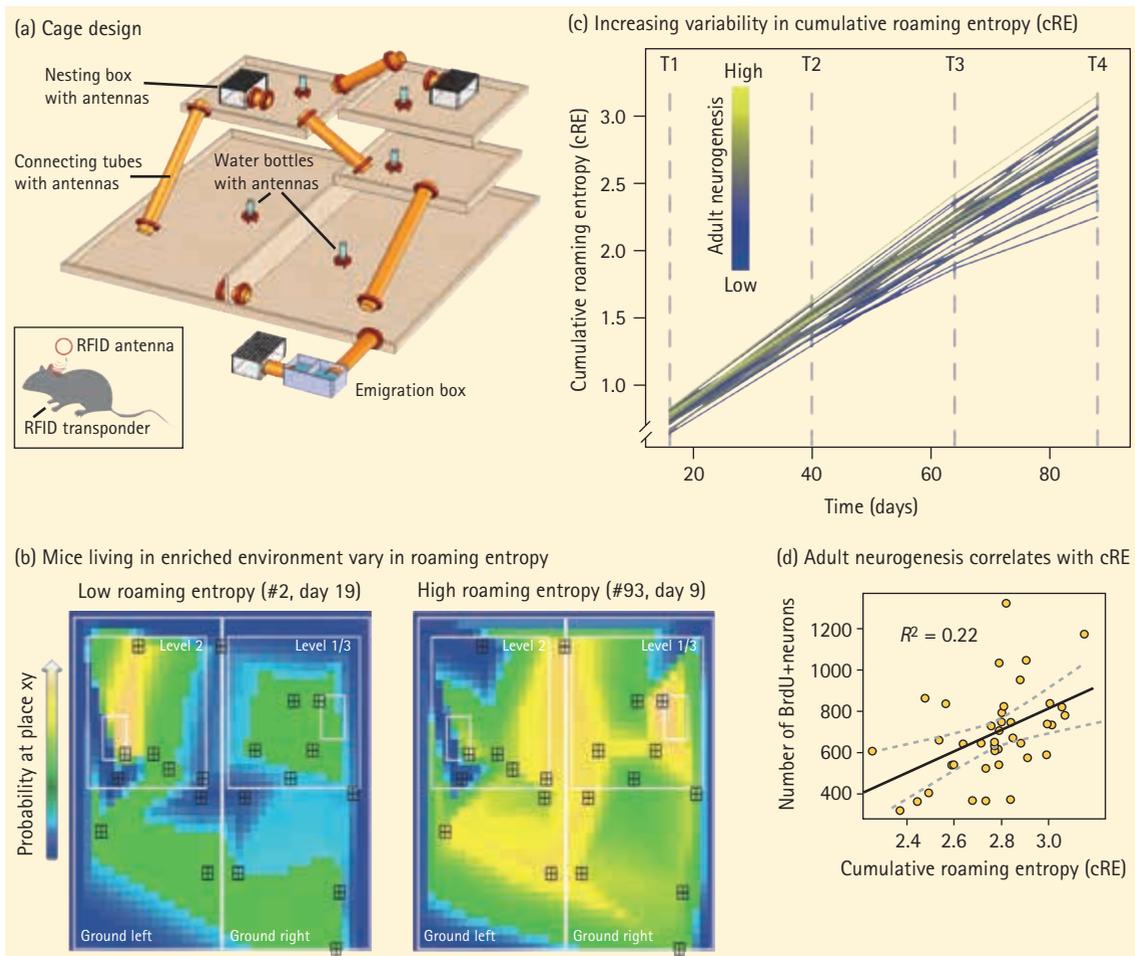
Center for Neurodegenerative Diseases (DZNE), Dresden, Andreas M. Brandmaier and Ulman Lindenberger introduced a new paradigm to better understand the contribution of development to individual differences. In the original experiment (Freund et al., 2013), the researchers observed 40 genetically identical mice that were kept in an enclosure offering a great variety of different options for exploration. The mice were equipped with tiny radio-frequency identification chips that emitted electromagnetic signals whenever they came across any of the antennas distributed throughout the cage. The researchers hypothesized that, despite their identical genetic makeup and exposure to a nominally identical environment, the mice would end up showing different behaviors and that these differences would increase over time. To quantify individual differences in exploration behavior, Andreas M. Brandmaier suggested roaming entropy (RE). RE was defined as the Shannon entropy of a spatial distribution describing the probability of finding a mouse at a particular location in the cage. Mice with low RE typically have local spatial distributions, that is, they restrict themselves to staying within certain limited areas of the enclosure. By contrast, mice with high RE make full use of the complex environment and show less preference for certain areas of the cage (see Figure 24).

The observed individual differences in behavioral trajectories were large and statistically reliable. Even more intriguingly, there was a correlation between RE and brain plasticity: Mice that explored their habitat more thoroughly also grew a greater number of new neurons in the hippocampus. Thus, with the help of advanced information-theoretic and statistical methods, including SEM, it was possible to show that personal experiences and individual behavior contribute to the

individualization of the brain. In a replication study (Freund et al., 2015), we investigated to what extent mechanisms of individualization have a social component. Together with Gerd Kempermann and his team, we will continue working with this animal model to address whether and how epigenetic mechanisms contribute to the emergence of individual differences.

## Exploratory Data Mining

Building models fully informed by theory is impossible when data sets are large and theoretical predictions are not available for all variables and their interrelations. In such instances, researchers may start with a core model guided by theory and then face the problem of which additional variables should be included. Brandmaier, von Oertzen, McArdle, and Lindenberger (2013) introduced SEM Trees to provide a versatile solution to this variable selection problem. SEM trees hierarchically split empirical data into homogeneous groups sharing similar parameters of a model by recursively selecting optimal predictors from a potentially large set of candidate predictors. SEM forests (Brandmaier, Prindle, McArdle, & Lindenberger, 2016) are a recent extension of SEM trees. They are large ensembles of SEM trees, each based on a random sample of the original data. By aggregating the predictive information in a forest, one obtains a measure of variable importance that is more robust than corresponding measures from single trees. Variable importance guides researchers on what variables may be missing from their models and the underlying theories. Brandmaier (2015) also continued to work on model-free tree structures for clustering time series. He proposed Permutation Distribution Clustering (pdc) as a novel clustering scheme that encodes dissimilarity between time series as differences in their complexity.



**Figure 24.** The emergence of individuality in genetically identical mice living in a nominally identical environment. (a) Shows a schematic illustration of the enclosure that housed 40 female mice. (b) Illustrates roaming entropy, which quantifies the coverage of space for a given individual. The heatmaps depict the probability of a mouse being at a specific location in the cage. Low probabilities are shown in blue, medium probabilities in green, and high probabilities in beige (see the arrow on the left). The boundaries of the cage, levels, and nesting boxes are indicated in white. The antenna positions are shown in black. The left panel shows a mouse with low roaming entropy (Animal No. 2 at day 19) and the right panel shows a mouse with high roaming entropy (Animal No. 93 at day 9). (c) Measurements of roaming entropy were aggregated into four adjacent time periods to obtain an index of cumulative roaming entropy (cRE). Each line displays the cRE for a single mouse. Corresponding levels of neurogenesis are continuously color coded from low (blue) to high (yellow). The mice differed reliably in rates of linear change in roaming entropy. (d) Individual differences in cumulative roaming entropy are associated with individual differences in adult hippocampal neurogenesis. The number of new neurons correlated significantly with cumulative roaming entropy at T4,  $r = 0.46$  ( $t = 3.227$ ,  $p = 0.0026$ ) (adapted from Freund et al., 2013).

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(last update: Spring 2017)

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# Harding Center for Risk Literacy

Director: *Gerd Gigerenzer*



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## Overview

In the 1930s, H. G. Wells predicted that, for an educated citizenship in a modern democracy, statistical thinking would be as indispensable as reading and writing. At the beginning of the 21st century, in a world full of uncertainty and risk, statistical thinking is indeed an indispensable skill. Nevertheless, people in OECD countries are rarely taught statistical thinking. The general lack of training to deal with uncertainties and risks in today's technological society has become a huge problem, as seen in various recent crises, such as BSE (mad cow disease), swine flu, EHEC (*Escherichia coli*), the financial crisis of 2008, and the euro crisis. At the Harding Center for Risk Literacy (Box 1), we investigate how people cope with risk and uncertainty, which major obstacles they face in understanding risk, and how risk information can be communicated more effectively.



"Our aim is to study how people behave in risk situations. We believe that our work can contribute toward the ideal of a society that knows how to calculate risks and live with them." *Gerd Gigerenzer*

Should I have a flu vaccination or not? Is it safer to travel by car or by plane? Can early-detection screening tests for cancer prolong my life? Questions like these are the research focus of a team of scientists led by Gerd Gigerenzer, director of the Harding Center for Risk Literacy.

The goal of the Harding Center is to help people understand and assess the risks facing them. Its primary focus is on health and medicine as well as on educating people from childhood onward to understand statistics. By conducting studies, experiments, and surveys, researchers at the Harding Center investigate people's difficulties in understanding numbers and then develop solutions. Importantly, they often leave the laboratory to study how real people make real decisions, for one by interviewing physicians and other experts as well as patients and other laypeople. Their research has been published in the top international journals in medicine (including *Annals of Internal Medicine*, *British Medical Journal*, *JAMA Internal Medicine*, *Vaccine*) and in psychological journals. Gerd Gigerenzer writes a regular column on the art of risk communication for the *British Medical Journal*.

In addition, the Harding Center is involved in physicians' initial medical training and continuing education, often in collaboration with leading universities, such as the Charité Universitätsmedizin Berlin and the Heidelberg University. Each year, members of the Harding Center hold around 50 keynotes, talks, and workshops for the medical community. Finally, the Harding Center aims to provide understandable health information to the public in collaboration with, for example, the Bertelsmann Foundation and health insurers in Germany and Switzerland.

The Harding Center for Risk Literacy was established in 2009. It is named after David Harding, who provided a generous endowment for the Center. Harding—global investment manager and director of Winton Capital—became aware of Gerd Gigerenzer's work after reading *Reckoning with Risk*, which was short-listed for the Royal Society Prize for Science Books. Since its foundation, the Harding Center has obtained additional funding from insurance companies and was recently awarded 1 million euros from the German Federal Ministry of Justice and Consumer Protection. The international success of the Harding Center led to the foundation of the Winton Center for Risk and Evidence Communication at the University of Cambridge, which is headed by the renowned statistician Sir David John Spiegelhalter and was inaugurated in London on 1 November 2016.

Box 1. Harding Center for Risk Literacy.

### Too Many People Do Not Recognize the Symptoms of a Heart Attack and Stroke

Are people knowledgeable of the warning signs of health risks, and do they know what to do in case of an emergency? Heart attacks and strokes are the most frequent causes of death worldwide; those who survive often face permanent impairment. Only quick medical attention can prevent many of these

outcomes. It is therefore critical that people recognize the signs and symptoms of a heart attack or stroke and know what to do if someone shows symptoms of either illness.

To learn what people know about the symptoms of a heart attack and stroke, Mata, Frank, and Gigerenzer (2014) conducted a representative survey of 10,228 people from Austria, Germany, France, Italy, Spain, the Netherlands,

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**Mata, J., Frank, R., & Gigerenzer, G.** (2014). Symptom recognition of heart attack and stroke in nine European countries: A representative study. *Health Expectations*, *17*, 376–387. doi:10.1111/j.1369-7625.2011.00764.x

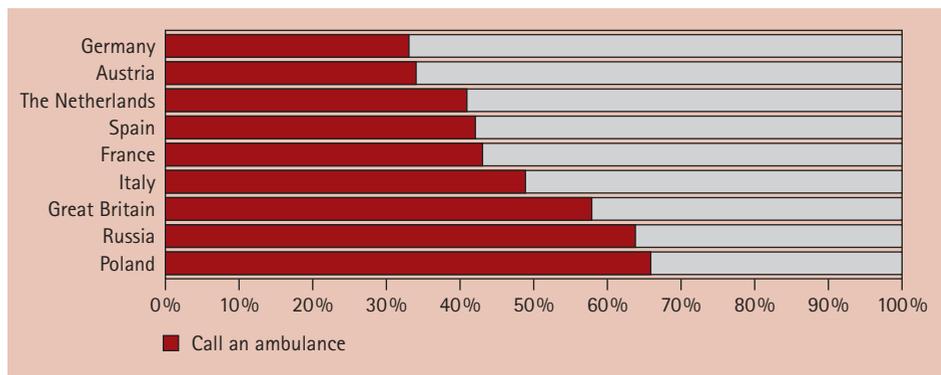


Figure 1. When encountering someone exhibiting symptoms of a stroke, how many people would take appropriate action? The graph shows the proportion of people across nine European countries who would call an ambulance if they saw a person showing symptoms of a stroke (adapted from Mata, Frank, & Gigerenzer, 2014).

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Great Britain, Russia, and Poland. Participants decided from a list of symptoms whether these were typical of a heart attack or stroke. Of six common symptoms of a heart attack, Germans recognized the highest number, 3.2 on average, whereas Italians, Poles, Spaniards, and Russians recognized less than two. Chest pain was the only heart attack symptom commonly known to more than half of Europeans, and approximately 8% did not know a single symptom that indicated a heart attack. The situation was even more precarious in the event of a stroke: Symptoms were completely unknown to around one fifth of Europeans in the study. Of the 14 symptoms of a stroke, it was again the Germans who recognized the highest number (5 on average). Does better knowledge of symptoms translate into taking more appropriate action in case of an emergency? Despite knowing the highest number of symptoms, few Germans or Austrians knew what to do if they saw a person with stroke symptoms. As Figure 1 shows, only one third of Germans and Austrians would immediately call an ambulance—which would ensure the fastest and best treatment for the patient. Instead, 28% of Germans and 30% of Austrians would recommend that the person drink a cup of tea or take a sip of water, or lie down and simply wait. On the other hand, two thirds of Poles and Russians and half of other Europeans knew what to do. Were people who had an increased risk of a heart attack or stroke better informed? Com-

pared to people of average risk, those with high blood pressure or hypertension did not recognize more symptoms. Strikingly, people who visited their doctor on a regular basis did not know what to do when experiencing stroke symptoms.

When it comes to improving health care, discussions often focus on more money and better technology to improve health outcomes. The results of this study demonstrate that health is first and foremost a problem of risk literacy and education.

### HIV Counselors Continue to Communicate an Illusion of Certainty About HIV Test Performance

In 1998, Gigerenzer, Hoffrage, and Ebert conducted an undercover study to examine how heterosexual men with low-risk behavior (monogamous, no intravenous drug abuse) were counseled about the accuracy of HIV test results. In their study, most counselors communicated the illusion of certainty: that false positives do not occur and that a positive HIV test result means that a client is certainly infected. In response to these worrying results, the authors provided feedback to all counseling centers in Germany along with guidance on how to improve counseling quality.

Sixteen years later, Prinz, Feufel, Gigerenzer, and Wegwarth (2015) replicated the study to assess whether HIV counseling in Germany has since improved. An undercover, low-risk

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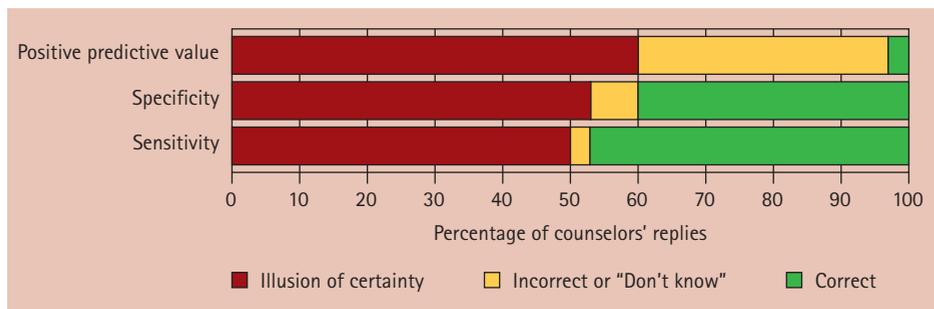


Figure 2. How certain are the results of a positive HIV test? More than half of German HIV counselors ( $n = 30$ ) incorrectly informed a low-risk client that a positive HIV test result meant that it was absolutely certain that the client had HIV. Counselors were better able to communicate the correct test statistics for HIV test specificity (true negative rate) and sensitivity (true positive rate), yet less than half of them counseled the client correctly (adapted from Prinz, Feufel, Gigerenzer, & Wegwarth, 2015).

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client attended 32 randomly selected counseling centers across Germany to evaluate the information counselors provided to their clients. (Two counselors, both social workers, refused to provide answers, reducing the sample size to 30.) Over the years since the original study, the HIV test procedure has improved such that the positive predictive value—the probability that a person is actually infected given that they test positive—has increased from 50% as in the original study to 96%. Nevertheless, this means that, among every 26 low-risk clients who test positive, one client is not actually infected. A positive test result then does not mean that it is absolutely certain that the client has HIV. Although the HIV test performance has improved in the 16 years since the original study, HIV counseling unfortunately has not. As shown in Figure 2, more than half of the professional counselors communicated an illusion of certainty for the test's sensitivity (true positive rate), specificity (true negative rate), and positive predictive value. Only one counselor correctly stated the latter.

### Overcoming Risk Illiteracy Is Simple With Honest and Transparent Information

To defeat risk illiteracy, risks need to be communicated in formats that build on people's competencies and promote comprehension. It is essential that health information is balanced and presents information about both the benefits and harms of health interventions. How-

ever, many health communication tools, such as cancer screening brochures, mislead the public with unbalanced and non-transparent information (Gigerenzer, 2014). For example, an analysis of German human papillomavirus (HPV) vaccination leaflets revealed that they do not meet the standards of balanced and transparent reporting (Neumeyer-Gromen, Bodemer, Müller, & Gigerenzer, 2011). How does unbalanced reporting affect girls' and parents' knowledge and actual decisions about HPV vaccination? And does balanced reporting make a difference?

Wegwarth, Kurzenhäuser-Carstens, and Gigerenzer (2014) surveyed 225 girl-parent pairs on knowledge about cervical cancer and the HPV vaccination, their perceived risk of the girls' developing cervical cancer without the vaccine, intention to have the girls vaccinated, and actual vaccination. Girls and parents were surveyed before and 14 months after receiving either a balanced or unbalanced HPV leaflet. Whereas unbalanced information tended to decrease people's knowledge of the HPV vaccination, balanced information increased it (see Figure 3). Moreover, balanced information improved perceived risk judgments and resulted in a better match between vaccination intentions and actual vaccination behavior. The original stated intention predicted actual vaccination decisions for 97% of the participants who were given the balanced information, but only for 60% of those who were given unbalanced

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- Gigerenzer, G. (2014). Breast cancer screening pamphlets mislead women: All women and women's organisations should tear up the pink ribbons and campaign for honest information. *British Medical Journal*, *348*:g2636. doi:10.1136/bmj.g2636
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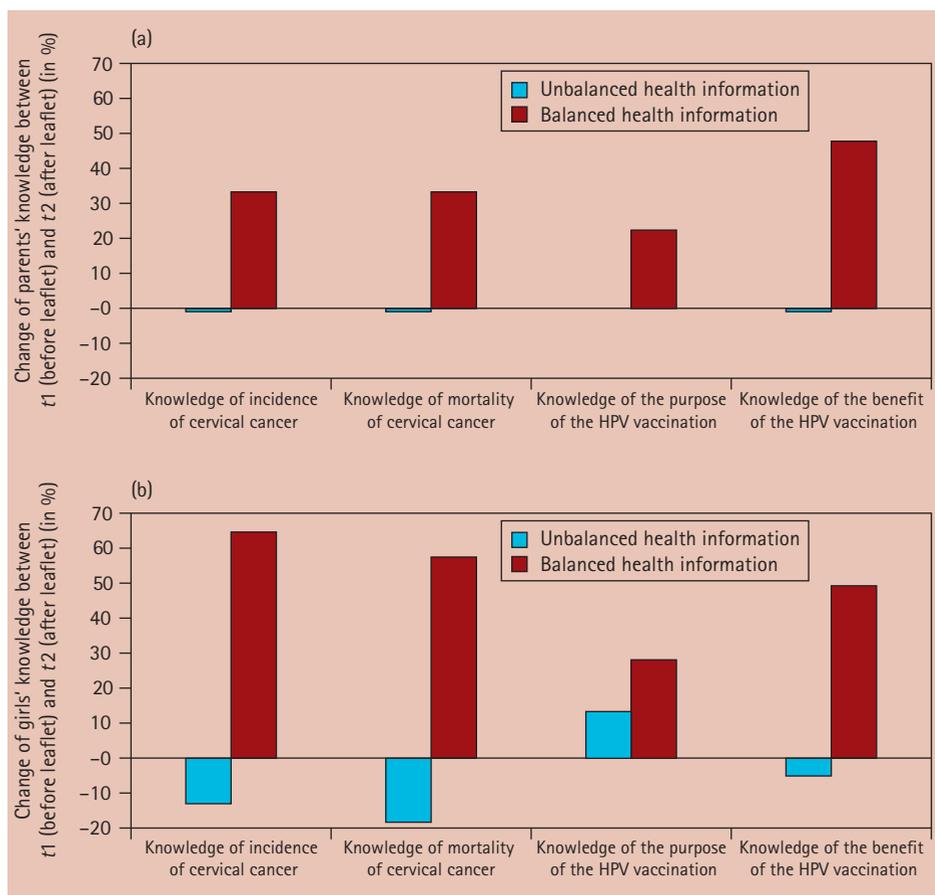


Figure 3. Does knowledge about cervical cancer and the benefits and harms of the human papillomavirus (HPV) vaccine improve when presented with a balanced (vs. unbalanced) information leaflet? The figure shows the change in knowledge from pre- to postpresentation when given a balanced (red bars) or unbalanced (blue bars) information brochure for (a) parents and (b) girls. Balanced information leaflets consistently improved knowledge about cervical cancer and the HPV vaccination for both parents and their daughters, whereas knowledge tended to decrease when the information leaflet conveyed unbalanced information (adapted from Wegwarth, Kurzenhäuser-Carstens, & Gigerenzer, 2014).

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information. These results provide evidence that balanced reporting about HPV vaccination increases informed decisions, does not undermine actual vaccination uptake, and reduces the “knowledge–behavior gap”—the mismatch between people’s knowledge and intentions, on the one hand, and their actual preventive health behaviors, on the other.

#### From Research to Practice: Health Insurers and Organizations Join Forces to Promote Risk Literacy

Good quality medical evidence needs to reach health professionals and the public.

Unfortunately, guidance is lacking on how to translate medical evidence into simple decision tools for physicians and patients. For example, how should medical evidence be summarized when there are gaps in evidence or when the evidence is unclear (e.g., uncertainty about the risk estimate)? To facilitate the construction of simple risk communication tools, McDowell, Rebitschek, Gigerenzer, and Wegwarth (2016) developed a guide for creating a fact box.

A fact box is a simple tabular summary of the best available medical evidence on the benefits and harms of health interventions and

- (1) A short summary sentence describing benefits and harms (without making a recommendation).
- (2) Clear specification of the reference class, age range, time frame of the study or assessment period, and other facts/caveats that may influence interpretation of the effects.
- (3) List of the most important benefits and harms (2–4 outcomes each) in the form of statements or questions.
- (4) Comparison of outcomes between two or more groups, typically between a control and intervention group and preferably from a systematic review.
- (5) A measure of the effect for each group, presented as (where possible) absolute *frequencies*: absolute numbers out of a total sample of 100, 1,000, or 10,000; *continuous scales*: mean, mean differences, or median, where appropriate; *unquantifiable outcomes*: a disclaimer or statement describing the state of evidence.
- (6) Sources for all information and the date the information was created or last updated.

*Box 2.* Key features of a fact box. A guide on how to create fact boxes facilitates the wide-scale development of fact boxes (McDowell, Rebitschek, Gigerenzer, & Wegwarth, 2016).

presents the evidence using transparent risk communication formats. As shown in Box 2, the guide details how to construct a fact box, what information to include and from which sources, and how to summarize and present the information. Crucially, the guide addresses key challenges to summarizing evidence, such as reporting on unavailable, missing, or insufficient information; dealing with conflicting evidence or imprecision; and differentiating between statistical and clinical significance. For each challenge, the guide offers multiple options for summarizing and presenting information in a fact box.

Ensuring that medical evidence is communicated transparently is one means of overcoming risk illiteracy. To promote public understanding of health risks, medical evidence must also be disseminated broadly. In 2014, the Allgemeine Ortskrankenkasse (AOK), the largest health insurance provider in Germany, serving around 24 million individuals, began a systematic program for developing and distributing fact boxes in collaboration with the Harding Center for Risk Literacy (Gigerenzer, in press). Figure 4 presents a fact box on ovarian cancer screening, one of 11 fact boxes released to the public and the press in May 2015. The fact box clarifies that there is no evidence that screening reduces deaths due to ovarian cancer (3 out of 1,000 in every group), while harming many women.

The Harding Center estimated that, in 2014, about 3 million German women were recommended an ultrasound for ovarian cancer screening, out of whom around 2 million underwent screening. As a result, an esti-

mated 17,000 healthy women aged 50 years and above had their ovaries unnecessarily removed; some of these women suffered from severe side effects and complications related to their treatment. The financial impact of screening was also costly. It was estimated that women paid around 75 million euros out of their own pocket for the ultrasound screening, and German health insurance providers had to pay millions to cover the costs of the diagnosis and treatment of women who were referred for further tests and procedures after receiving suspicious screening results. To facilitate informed decision making about ovarian cancer screening, the fact box highlights both the benefits and harms of screening in a simple format that patients and health professionals can readily understand. The response to the fact box was overwhelmingly positive, with over 100 newspaper articles published in the days following the press conference. As of 2016, alongside the AOK, two additional health insurers have taken up the challenge of promoting fact boxes to the public in collaboration with the Harding Center. Helsana, a Swiss health insurer, has released six fact box videos online, and the German health insurer Viactiv Krankenkasse plans to release fact box videos beginning in 2017. Since 2013, the Bertelsmann Foundation has developed 15 fact boxes for its health information website *Faktencheck Gesundheit*. These collaborations are large steps toward the goal of ensuring that evidence-based medicine reaches health professionals and the public on a wider scale.

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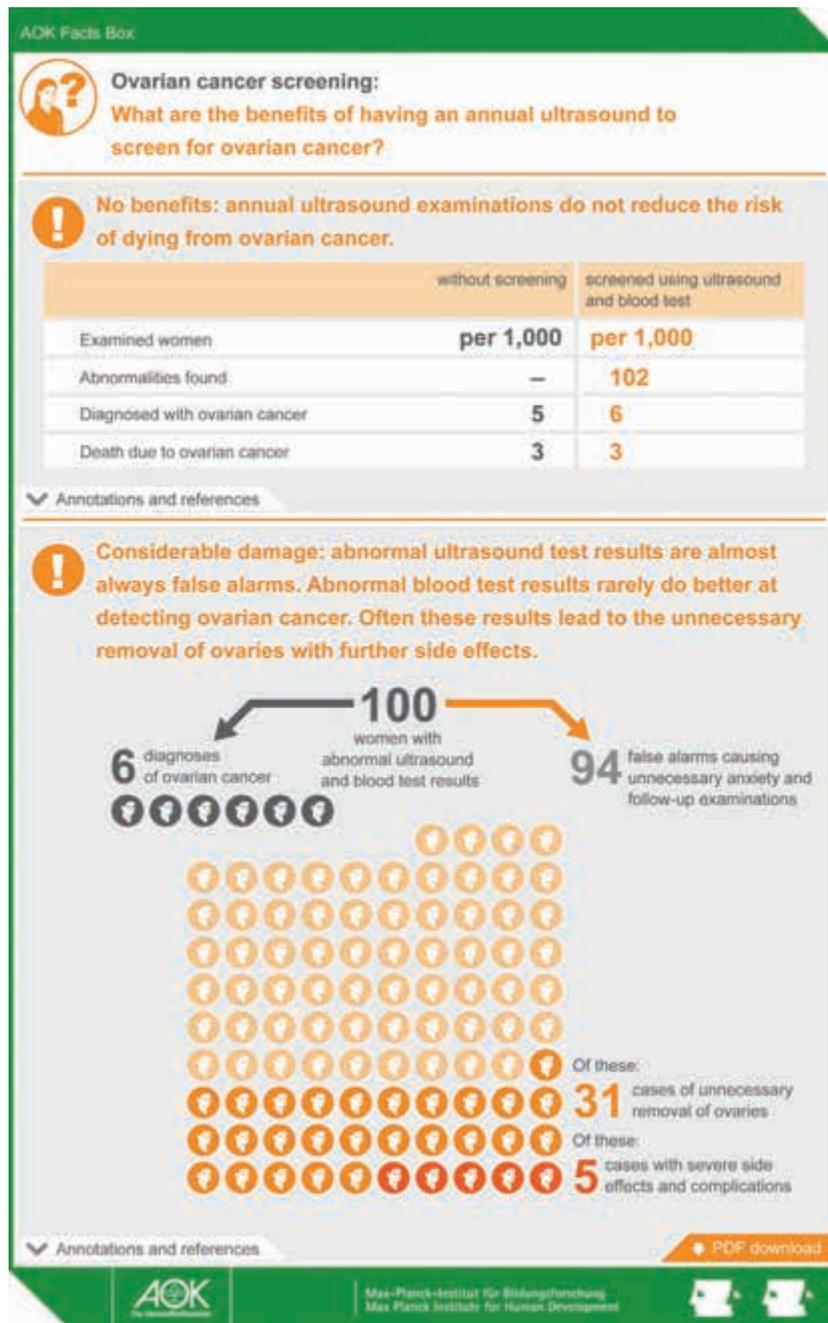


Figure 4. A web-based fact box on ovarian cancer screening. This is one of 11 fact boxes produced in an ongoing collaboration between the Harding Center for Risk Literacy and the Allgemeine Ortskrankenkasse (AOK), the largest health insurance provider in Germany. In the upper part of the figure, information about the benefits of screening are provided, starting with a summary line and followed by absolute numbers for each benefit outcome. This presentation allows readers to easily compare the outcomes for women who do and do not undergo screening. In the lower part, the harms are summarized and then presented visually in an icon array. The icon array highlights that, out of every 100 women who received a suspicious screening test result, only 6 had ovarian cancer and 94 were falsely alarmed. Of these, 31 unnecessarily had an oophorectomy, with some experiencing severe complications. Further information, such as details about the study from which the numbers were drawn, can be obtained by clicking the “annotation and references” button.

Source. [www.aok.de/faktenboxen](http://www.aok.de/faktenboxen).

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(last update: Spring 2017)

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**Max Planck UCL Centre  
for Computational Psychiatry  
and Ageing Research**

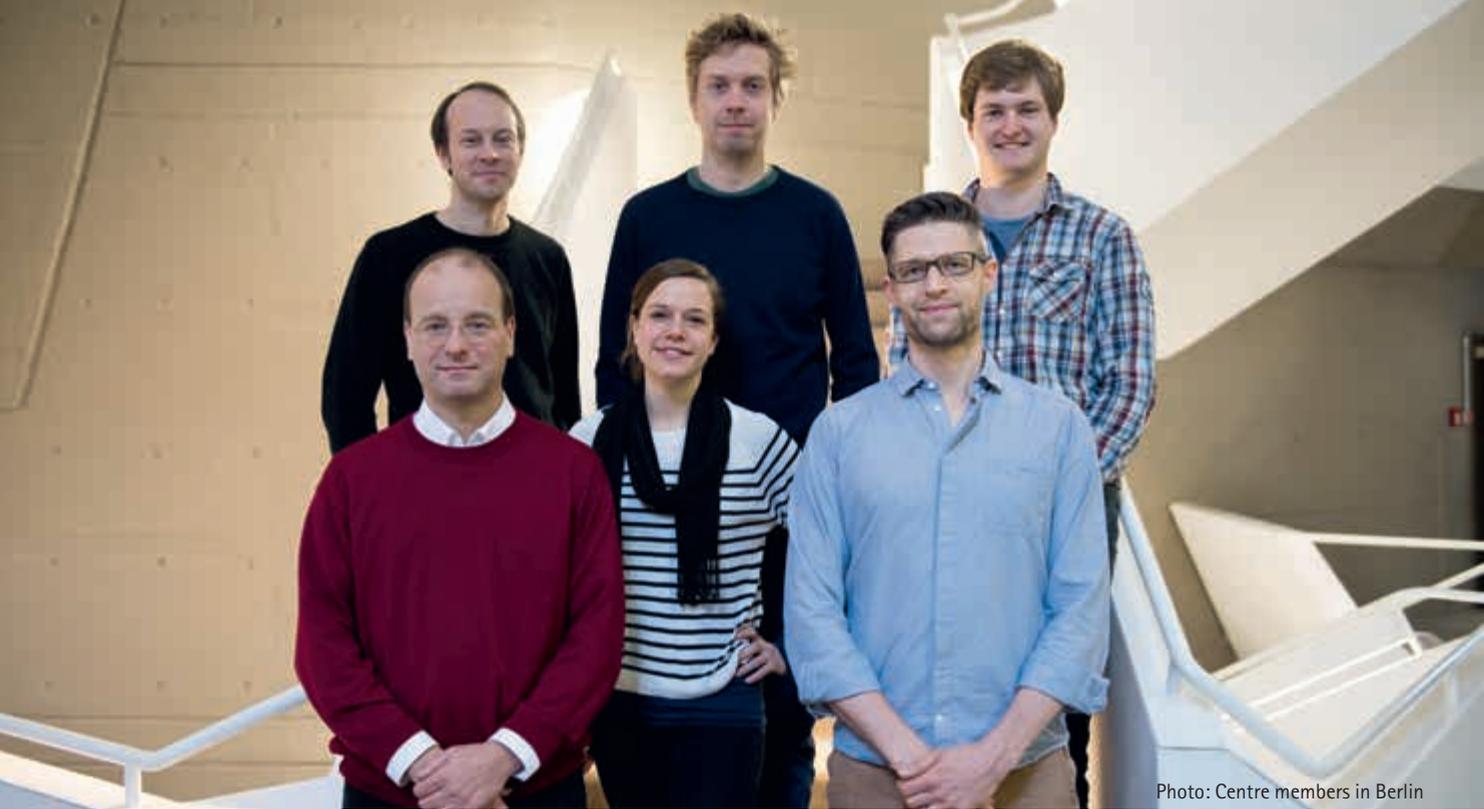


Photo: Centre members in Berlin

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## Overview

The behavioral neurosciences and related disciplines have seen spectacular scientific advances that make them rich in scientific opportunity. These advances have made it possible to work toward a mechanistic understanding of behavioral aging and psychopathology, two empirically overlapping fields of great importance to science and society. In both fields, it is of key importance to take a personalized lifespan approach by identifying neural and behavioral parameters that predict more or less favorable trajectories, with the intent to intervene in time when undesirable outcomes are expected.

With these goals in mind, the Max Planck Society (MPS) and University College London (UCL) have established the *Max Planck UCL Centre for Computational Psychiatry and Ageing Research*. The Centre's opening ceremony took place in London at the Royal Society on 1 April 2014. MPS and UCL have provided funding for the Centre for an initial period of 5 years. The Centre has two sites, one in London (Russell Square) and the other in Berlin-Dahlem (MPI for Human Development). The Centre's foundation was preceded by a 3-year preparatory phase, which also included the organization of the *First Symposium and Advanced Course on Computational Psychiatry and Ageing Research* in 2012 at Ringberg Castle, Bavaria. During the reporting period, the Centre organized two further such symposia in 2014 and 2016, again at Ringberg Castle. In 2016, MPS and UCL jointly launched the *International Max Planck Research School on Computational Methods in Psychiatry and Ageing Research* (COMP2PSYCH) to extend the Centre's reach into graduate education (see p. 293 for details).

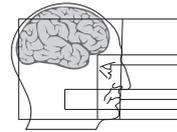
Below, we summarize the activities of the Centre's *Lifespan Neural Dynamics Group*, which is located in Berlin. In addition, the *Formal Methods* project of the Center for Lifespan Psychology (see pp. 172–174) is affiliated with the Centre. A full overview of the Centre's activities, including those primarily based in London, can be found on the Centre's website.

### The Lifespan Neural Dynamics Group

Various subdisciplines within neuroscience have long shown that the brain is inherently dynamic and variable across moments at every level of the nervous system. The Lifespan Neural Dynamics Group (LNDG)

led by Douglas Garrett pursues the general hypothesis that variability may be highly functional for neural systems, indexing important benefits such as greater dynamic range and systemic flexibility and adaptability (see Garrett et al., 2013). Viewed from this perspective, and in contrast to earlier notions of "neural noise," normal cognitive aging can be reframed as a generalized process of increasing system rigidity and loss of dynamic range that manifests in reduced brain signal variability. The group tests this conceptualization by examining electroencephalographic (EEG) and functional magnetic resonance imaging (fMRI) brain signal variability and dynamics in relation to lifespan development, cognition, neurochemistry, network dynamics, and brain structure. A brief selection of our current findings and approaches can be found below.

The LNDG continues to build on its work showing that older, poorer performing adults often exhibit less moment-to-moment variability in brain signals under a host of different task conditions (see Garrett et al., 2013). First, the group has taken an explicit interest in how the level of cognitive demand influences the degree of signal variability expressed within an individual. Using multivariate and mixed modeling of fMRI-based parametric face processing data in younger adults, the group showed that the within-person signal variability level responds to incremental adjustments in task difficulty (i.e., increasing image noise; see Figure 1) and that difficulty-related reductions in signal variability predicts reduced accuracy and longer reaction times within persons (Garrett, McIntosh, & Grady, 2014). Conversely, follow-up work suggests that older adult levels of signal variability do not



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Nyberg, L., Karalija, N., Salami, A., ... Garrett, D. D., ... Lövdén, M., Lindenberger, U., & Bäckman, L. (2016). Dopamine D2 receptor availability is linked to hippocampal-caudate functional connectivity and episodic memory. *Proceedings of the National Academy of Sciences (USA)*, 113, 7918–7923. doi:10.1073/pnas.1606309113

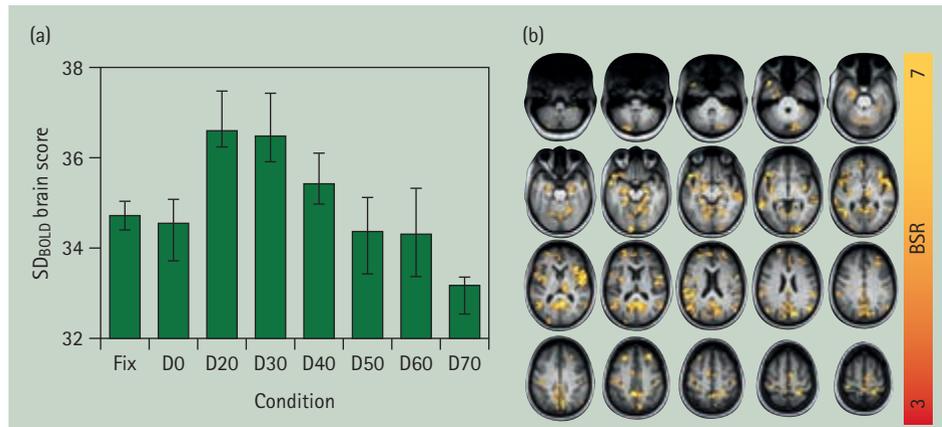


Figure 1. (a) Nonlinear, within-person parametric modulation of blood oxygen level-dependent signal variability ( $SD_{BOLD}$ ) with increasing task difficulty. Upon an initial level of task demand (D20–D30),  $SD_{BOLD}$  increased and then continually decreased as participants approached their own limits of face processing (D70). This effect was expressed in (b) yellow/red brain regions. Fix = fixation condition; D0–D70 = increasing difficulty on a face processing task; BSR = bootstrap ratio indicating threshold level for brain regions (adapted from Garrett, McIntosh, & Grady, 2014).

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respond well to differing levels of cognitive demand, indicating muted response dynamics to visual input.

LNDG research has recently expanded to better establish the neurochemical (dopaminergic, DA) basis of age- and performance-graded differences in signal dynamics (Garrett et al., 2015). Given that normal aging is associated with DA decline and poorer cognitive performance, and that poorer cognitive performance characterizes generalized aging-related reductions in brain signal variability, it was predicted that pharmacological agents that boost systemic DA such as amphetamine (AMPH) would restore deficient signal variability levels in older adults during a parametric working-memory task. As hypothesized, older adults expressed lower signal variability on placebo, but matched or exceeded young adult variability levels in the presence of AMPH (see Figure 2). Notably, select older adults also improved in cognitive performance when signal variability was boosted on AMPH. These findings support the hypothesis that age differences in brain signal variability reflect aging-induced changes in DA neuromodulation. LNDG has expanded this work within studies linking DA binding, assessed by positron emission tomography (PET), to (1) blood oxygen level-dependent (BOLD)

signal variability in younger and older adults (Guitart-Masip et al., 2016), and continues to link DA PET more broadly to (2) cognition and fMRI (networks, mean signals, moment-to-moment brain dynamics) in the *Cognition, Brain, and Aging* (COBRA) study of 180 older adults (e.g., Nyberg et al., 2016). The group has also investigated the notion that age-related changes in brain signal dynamics may not be confined to the variance of BOLD signals. In particular, the entropy (i.e., stochasticity) of a biological system is a purported proxy for a biological system's ability to adapt and function in an ever-changing environment. In collaboration with the *ConMem* and *Formal Methods* projects in the Center for Lifespan Psychology (pp. 148–152 and pp. 172–174, respectively), the group's latest EEG research has examined age-related brain signal entropy at multiple time scales when participants are at rest. Following in-house development of a novel within-person measure of entropy that compares each subject to randomly shuffled versions of their own brain data, younger adults ( $n = 40$ ) were found to exhibit higher entropy at nearly all time scales and electrodes than older adults ( $n = 40$ ). Younger adult brains simply appear more "information-rich" across moments.

Other published work on entropy within LNDG (Grandy, Garrett, Schmiedek, & Werkle-Bergner, 2016) has focused on resolving important methodological constraints in the application of multiscale entropy (MSE) to some classes of neural signals, such as the apparent need for long-time series. Using simulated, EEG, and fMRI data, the group found that MSE estimation across discontinuous temporal segments (typical of modern cognitive neuroscience designs) was as precise as if the data were continuously acquired. These findings thus permit a wider range of MSE applications when gauging moment-to-moment dynamics in sparse or discontinuous neurophysiological data.

In further ongoing work, Niels A. Kloosterman completed a simultaneous eyetracking-fMRI project focusing on the role of neural variability in how younger and older individuals explore and recall pictures of everyday scenes, serving as a first examination of real-time coupling between behavioral and neural variability. Iris Wiegand recently embarked on an EEG project examining whether changes in "states" of brain signal entropy can be

attentionally cued, both within younger and older adults.

Neuroenergetics theory posits that sustained deviations from cerebral metabolic homeostasis put constraints on neural structure and function, which may be related to important aspects of behavior. In close collaboration with Nils C. Bodammer, the group is using a novel in-vivo imaging method for phosphocreatine, a proxy for such regional homeostasis (Dissertation Julian Q. Kosciessa; see also pp. 170–171). The major goal of the dissertation is to explore potential links between local energy mismatch of supply and demand in the brain under task conditions and the ensuing consequences for neural dynamics and behavioral performance.

Finally, LNDG research has culminated in a successful five-year Emmy Noether grant (2016–2021; to Douglas G. Garrett) from the German Research Foundation (DFG). It allows the group to investigate individual differences and longitudinal change in three key factors (i.e., brain structure, static/dynamic functional connectivity, and dopamine) that may drive age-related brain signal variability.

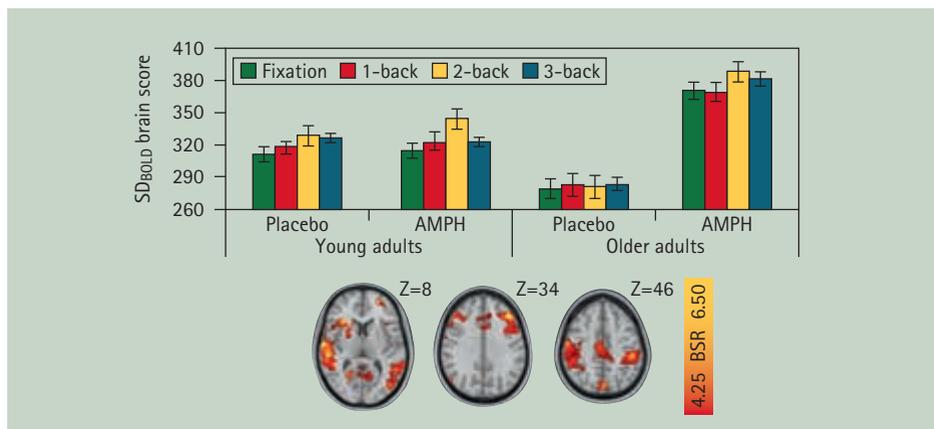


Figure 2. Amphetamine (AMPH) boosts  $SD_{BOLD}$  in older adults in key white-matter regions (e.g., bilateral dorsolateral prefrontal cortex, left putamen/caudate) during an n-back working-memory paradigm. BSR = bootstrap ratio indicating threshold level for brain regions (adapted from Garrett et al., 2015).

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(last update: Spring 2017)

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**Max Planck Research Group**

Naturalistic Social Cognition

Head: *Annie E. Wertz*



Photo: Members of the group with assistants

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Annie E. Wertz

*Postdoctoral Fellows*

Claudia Elsner, Valentina Fantasia

*Predocctoral Fellows*

Karola Schlegelmilch (LIFE), Aleksandra Włodarczyk (LIFE)

## Introductory Overview

How do infants and young children learn about the world around them? This overarching question is the foundation for the research carried out by the Max Planck Research Group “Naturalistic Social Cognition.” The work of this group is primarily focused on investigating how infants and young children learn about plants—an important, but often overlooked, aspect of the natural world. The group began its work in 2015.

At first glance, this may seem like an odd research program. Why would anyone need to learn about plants? And why would we expect infants to be able to do this? These are reasonable questions given the way that most of us encounter plants in our modern Western lives. Plants are part of the background scenery as we walk through parks or in the forest, and they are the neatly arranged objects on supermarket and garden store shelves. Living in such circumstances can lead to the conclusion that plants are an incidental and uncomplicated part of human life. While this may be true for many of us today, the circumstances our ancestors faced over evolutionary time were very different.

Taking as a starting point the emergence of the genus *Homo*, humans lived as hunter-gatherers for about 99% of our evolutionary history. Studies of the archeological record and of modern hunter-gatherer populations indicate that plants were fundamental to human life during this time. Plants were sources of food and raw materials used for constructing shelters and other artifacts. Of course, in a hunter-gatherer world, the plants people consumed did not come prepackaged in a store. Instead, they had to be gathered from wild environments.

Identifying the edible or otherwise useful plants in natural environments is no easy task. Plant life varies widely across the types of environments in which humans live. Further, plants are in coevolutionary relationships with many different animal species and consequently do not reliably signal whether they are edible or toxic to humans. Therefore, simple rules such as “eat all plants with round leaves” or “avoid all purple fruits” simply do not apply. What is required of people living in such environments is to identify the individual plant species that can be consumed and those that should be avoided. Consistent with this

proposal, studies have shown that modern hunter-gatherers and hunter-horticulturalists can identify hundreds, and sometimes thousands, of different plant species.

Our research focuses on how individuals acquire this information about plants over the course of ontogeny. Trial and error learning, in which each individual directly samples different plant species and experiences the consequences, is not an effective strategy for learning about plants. Given the prevalence of toxins in plants, this strategy could result in frequent illness and perhaps even death. Therefore, we propose that human cognitive architecture contains specialized behavioral strategies and social learning rules that facilitate the safe acquisition of information about plants from more knowledgeable individuals.

We investigate this proposal with infants to uncover the structure of the social learning system early in ontogeny (see Box 1). Further, we argue that at least some parts of this system may be designed to operate during the period of infancy itself, rather than acting only as building blocks for aspects of cognition that becomes useful later in development.

### Our Research Program

The research conducted in our group is organized into three main topic areas: (1) investigating the protective behavioral strategies that infants use to mitigate plant dangers, such as poisoning and physical injury; (2) examining the selective social learning rules that infants use to acquire relevant information about plants from others (e.g., edibility); (3) exploring how these plant specific behavioral avoidance strategies and selective social learning rules operate “in the wild” by using a combination of naturalistic observations and cross-cultural and comparative methods.

## Methods of Studying Infant Cognition

We use a variety of techniques to investigate infant cognition. Infants are not capable of participating in the kinds of experimental paradigms used with older children or adults. However, by precisely recording what infants look at, what they reach for, and the kinds of behaviors they show in carefully crafted experimental situations, we can make firm inferences about infants' underlying cognitive processes.



**Figure 1. Visual attention techniques.** These methodologies measure where and for how long infants look at different experimental displays. Using precisely designed stimuli, infants' visual attention patterns reveal what kinds of changes they notice, what types of events they expect, and how they process visual information. We use two different visual attention techniques in our research. The first technique is live looking time coding, in which a trained observer sits out of view of the infant and records how long the infant looks at different events using a computer program. The second technique makes use of an eye tracker to record detailed information about where infants are looking within a particular display. The eye tracker emits a harmless infra-red light and measures the reflections from the infant's cornea and pupil to precisely record the infant's gaze patterns.



**Figure 2. Reaching paradigms.** Infants' reaching behavior can be as informative as their visual attention. Choice paradigms present two objects to infants simultaneously and use their reaching behavior as an indication of their preference for one object over the other. Many of our studies use a "time-to-touch" paradigm in which we measure infants' latency to touch individual objects that are presented serially. By comparing infants' latencies to touch different types of stimulus objects, we can make inferences about the types of objects infants avoid. In general, we present our stimuli for a given experiment within-subjects to account for individual differences in reaching speed, and we counterbalance the order in which the objects are presented across infants to mitigate order effects at the group level.



**Figure 3. Behavioral coding.** Video recordings of infant behavior can be rich sources of data. To standardize the types of behaviors we are interested in, we develop coding schemes that precisely operationalize what is counted as, for example, a "look" or a "touch" in a particular study. With the help of behavioral coding software, our research assistants comb through video recordings to identify when and how often behaviors of interest occur. This technique can be used with videos of our tightly controlled laboratory studies, as well as with videos of infants and young children in naturalistic settings.

Box 1.

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## Research Area 1: Protective Behavioral Strategies

This first research area examines whether infants possess behavioral strategies to avoid the type of harm that plants can cause. Plants manufacture a variety of different defenses to deter the herbivores that feed on them. These defenses include toxic chemical compounds and injurious physical structures like thorns and stinging hairs. Therefore, the primary dangers plants pose are poisoning and physical injury. Previous research has shown that infants and young children are sensitive to other kinds of ancestrally recurrent entities that are capable of harming them, such as snakes, spiders, other types of dangerous animals, and individuals displaying angry facial expressions.

However, plant threat is different than the dangers posed by these other entities for one simple reason: Unlike dangerous animals, plants cannot move around on their own. They are, quite literally, rooted to the spot.

This means that a dangerous plant cannot inflict serious damage unless one approaches the plant and makes physical contact with it by, for example, grabbing it or consuming part of it. As a result, a simple behavioral strategy

of minimizing physical contact with plants can be quite effective in minimizing exposure to plant dangers. This type of behavioral avoidance strategy, acting in concert with previously established gustatory and metabolic plant toxin mitigation processes, would serve to protect human infants from physical injury and poisoning by plants. Further, because fatally toxic plants can look quite delicate and beautiful, the best behavioral avoidance strategy is to minimize contact with any unknown plant, regardless of how it may look, until one has some additional information about it. Therefore, we predicted that, prior to receiving social information from adults, infants would be reluctant to touch plants compared to other types of entities. In the first study to test this proposal, we presented 8- to 18-month-old infants with a series of objects across two different experiments (Wertz & Wynn, 2014b). These objects were real plants, realistic-looking artificial plants, novel manmade artifacts, familiar manmade artifacts, and naturally occurring entities (see Figure 4). The real plants were basil and parsley plants. The artificial plants were included to ensure that we had plant exemplars that would not grow and change over the course of data collection and did not have a strong scent. The novel artifacts shared features with the plants: One was made out of the same leaves as one of our artificial plants and the other was green in color and

constructed to have tendrils sticking up from the top of it. These objects allowed us to examine whether infants would respond to plants per se or to more general features, such as certain shapes or colors. We also included objects that would be familiar to infants, namely, a spoon and a small lamp, to test whether infants would react differently to broader categories of familiar entities versus unfamiliar ones. Finally, we included seashells to test how infants would react to other kinds of naturally occurring inanimate objects. Infants sat on their parent's lap while a researcher placed each object in front of them, one at a time (see Box 1, Figure 2). The researcher maintained a neutral expression throughout the study, and the object presentation order was counterbalanced across infants. The amount of time it took for infants to touch each stimulus object was subsequently coded from videos of the sessions. As predicted, infants took longer to reach out and touch plants, both real and artificial, compared to all of the other object types (see Figure 5). Further analyses confirmed that this reluctance was specific to the plants in our stimulus set and not to more general features. For example, infants did not avoid all green entities nor did they avoid all objects with leaf-shaped parts. Infants did not respond differently to novel entities compared to familiar entities more generally, and they showed no hesitation to touch other types of naturally

#### Key Reference

Wertz, A. E., & Wynn, K. (2014b). Thyme to touch: Infants possess strategies that protect them from dangers posed by plants. *Cognition*, 130, 44–49. doi:10.1016/j.cognition.2013.09.002



Figure 4. Stimulus objects presented to infants in the behavioral avoidance experiments of Wertz and Wynn (2014b).

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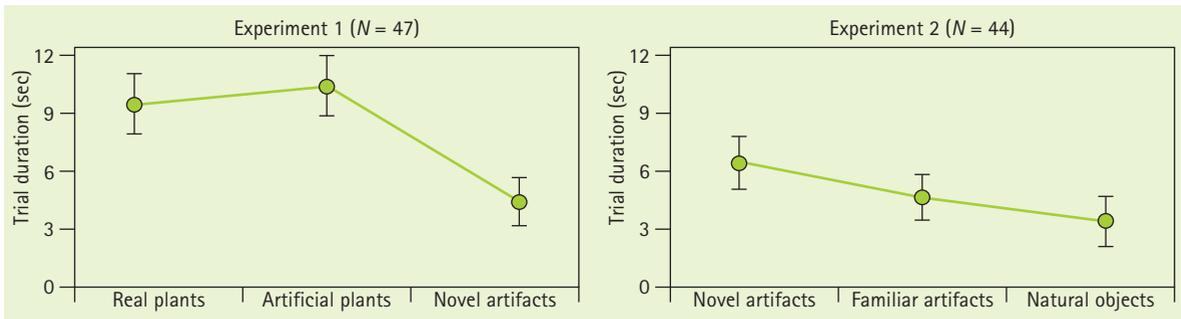


Figure 5. Infants' time to touch different types of stimulus objects presented across two experiments. As predicted, infants look longer to reach out and touch plants, both real and artificial, than all of the other stimulus types (adapted from Wertz & Wynn, 2014b).

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occurring objects (i.e., seashells). Finally, infants were just as reluctant to touch artificial plants as real ones, demonstrating they were not simply avoiding objects with a scent. These results provided the first empirical evidence for a plant specific behavioral avoidance strategy in human infants. Without clear social information from adults, infants do indeed take longer to reach out and touch plants than other entities. This strategy minimizes infants' physical contact with plants,

protecting them from the types of dangers that plants can inflict.

We have now replicated and extended this initial finding in two separate studies recently completed in the Institute's BabyLab. These studies investigated two critical features of infants' reluctance to touch plants: First, are infants' responses to plants affected by the presence of visibly threatening features like thorns? Second, what are infants doing during the initial delay to touch plants? In both stud-



Figure 6. The full set of stimulus objects that has been used to test 8- to 18-month-old infants' reluctance to touch plants to date. Infants take longer to touch plants, both real and artificial, than all of the other stimulus types.

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ies, we measured infants' latency to touch a broader array of stimulus objects and found that infants took longer to reach out and touch plants compared to all of the other object types we tested (see Figure 6). The papers for both of these projects are currently under revision or in preparation, so we will provide only a brief preview of both studies here.

### Presence of Visibly Threatening Features

The logic of the behavioral avoidance strategy is that it should be applied to all plants, regardless of how they look. However, unlike toxic chemical compounds, the presence of physical defenses like thorns is visibly detectable. In this study, we tested whether infants' behavioral avoidance strategies were influenced by the presence of visually detectable plant threats. To do this, we presented infants with plants, novel artifacts matched to features of the plants, and familiar artifacts. Half of the stimulus objects in each category had pointed thorn-like shapes, while the other half did not. The pointed shapes on the plants and novel artifacts were made of child-safe modeling clay to look like thorns. The two pairs of familiar objects were similar looking overall with one object in each pair having pointed features (e.g., a mirror and a hairbrush).

Forty-two 8- to 18-month-old infants were brought to the Institute's BabyLab and presented with 12 stimulus objects, one at a time, in a randomized order. We measured infants' time to touch each object as well as their touching behavior for 5 seconds after their initial contact with each object (see Figure 7). Infants took longer to reach out and touch plants, whether or not they had thorns, compared to the other object types, replicating our previous result. Further, after making initial contact with each object, infants spent less time touching plants compared to novel and familiar artifacts, and they touched the thorny parts of plants less frequently than either the thorny or nonthorny parts of any of the other object types. These results suggest that, in addition to the initial delay to touch plants, infants' behavioral avoidance strategy also includes minimizing their subsequent physical contact with plants. This was true for plants with thorns and those without, but



Figure 7. Infants' manual exploration behaviors with plants (top row) and nonplant control objects (bottom row). In this study, half of the stimulus objects had pointed thorn-like shapes (right panels) while the other half did not (left panels).

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appears to be particularly pronounced for the thorny parts of plants.

### Social Information Seeking During the Touch Delay

The purpose of this study was to further investigate infants' behavior before they make physical contact with plants. We argue that the purpose of the behavioral avoidance strategy is to protect infants from making contact with a plant before they know whether it is safe or dangerous. Therefore, we predicted that infants would actively seek out information from other people when they are confronted with plants. Critically, we predicted that this increased social information seeking should occur *before* infants make physical contact with a plant.

To test this, we brought another group of 8- to 18-month-olds ( $N = 42$ ) to the Institute's BabyLab and placed a series of 20 stimulus objects—real and artificial plants, novel artifacts, familiar artifacts, and naturally occurring objects—in front of them, one at a time, in a counterbalanced order. The objects were presented to each infant in two sessions separated by a short break: In one session, the objects were presented close enough that infants could touch them (as in the studies above) while, in the other session, the objects were presented

out of infants' reach. Here, we will preview the results for the within-reach session only. Our main interest was in infants' social information-seeking behavior. Therefore, we measured *social referencing*, that is, instances in which



Figure 8. An infant exhibiting social referencing during the study. The experimenter places each stimulus object on the table in front of the infant in a randomized order. The experimenter maintains a neutral expression throughout and looks at the table instead of the infant. The parent's eyes remain closed throughout the session so that they cannot inadvertently influence their infant's responses.

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infants' gaze was first directed at a stimulus object and then immediately at the face of an adult (see Figure 8). We also measured infants' reaching behavior to determine when they first made contact with each stimulus object.

As predicted, our results indicate that infants do indeed engage in more social referencing for plants compared to all other object types (see Figure 9). Importantly, this increase in social referencing occurs before infants touch plants and only when the plants are presented within their reach, which is precisely what would be expected if this behavior were part of a behavioral avoidance strategy that protects infants from plant dangers. Further, we replicated the finding that infants take longer to reach out and touch plants, but the increase in social referencing behavior was not simply a consequence of this fact. Infants' increased social

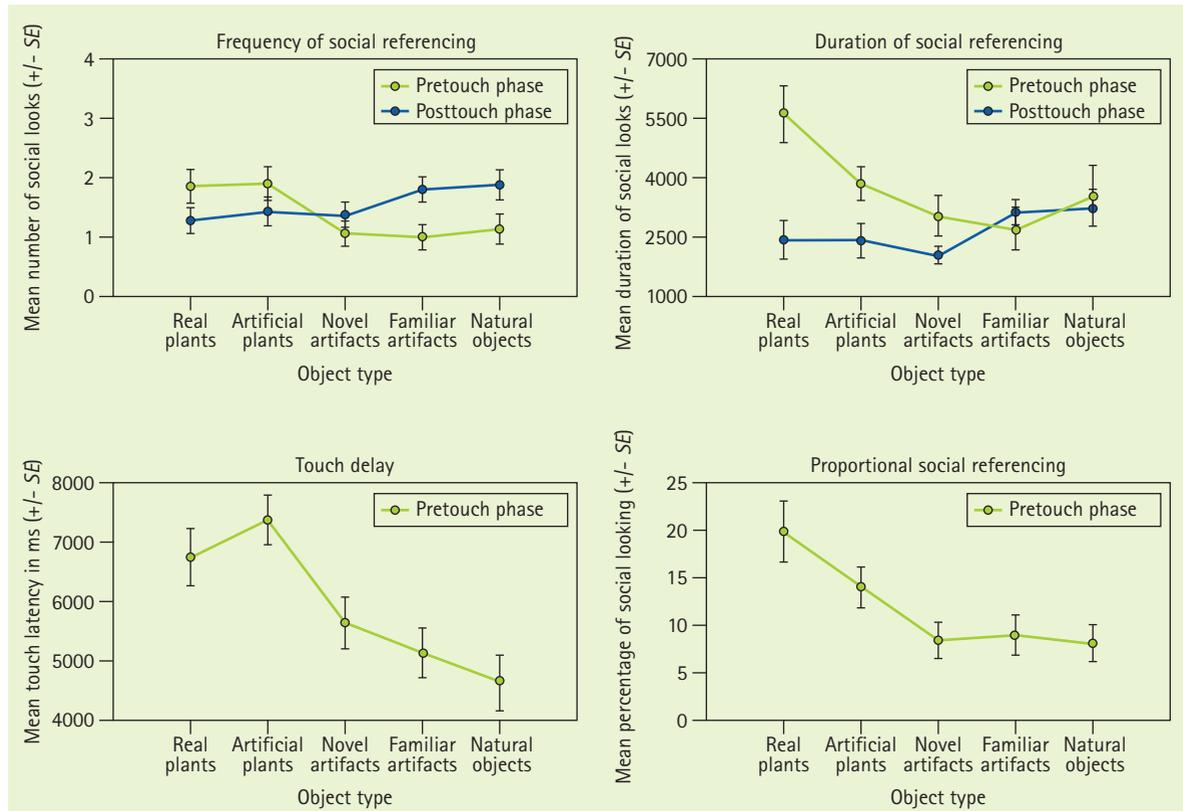


Figure 9. Frequency (top left) and duration (top right) of infants' social referencing when the stimulus objects were presented within infants' reach. Infants exhibited more frequent and longer durations of social looks for plants than the other object types. Infants again exhibited a greater reluctance to touch plants (bottom left). A proportional analysis (bottom right) revealed that even when controlling for the longer amount of time before infants touch plants, infants exhibited more social referencing behavior when confronted with plants (adapted from Elsner & Wertz, under review).

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information seeking for plants remained even when statistically controlling for the amount of time before infants touched each object. This kind of increased social information seeking, operating as part of a behavioral avoid-

ance strategy, puts infants in the best position to glean information from others before making contact with potentially dangerous plants and sets the stage for further social learning processes.

## Research Area 2: Selective Social Learning

Our second area of research explores the social learning processes that infants use to acquire information about plants from other people. To date, the studies have explored one important type of information relevant to plants: edibility. However, there is more to be learned about plants than whether or not they can be eaten. Therefore, our planned future studies will expand the scope of this investigation to include the acquisition of other types of information (e.g., socially conveyed signals of danger, information about usefulness in artifact construction, etc.).

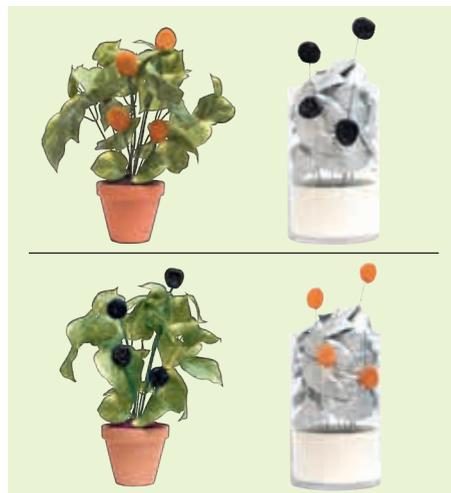
Humans have relied on gathered plant resources for food throughout our evolutionary history. Therefore, we began our work in this research area by investigating whether human cognitive architecture includes procedures for identifying edible plants. Previous research has addressed related areas: foraging and food learning. Aspects of foraging behavior have been well studied in humans and other species. For example, the time spent foraging at particular patches given the caloric return and spatial distribution of different food items. Further, a growing number of studies of food learning processes in infancy and early childhood underscore the importance of social learning to human food learning. However, given the importance of food learning, there is still surprisingly little experimental work on this topic. In both cases, the processes by which certain resources are identified as food items in the first place remain largely unexplored.

Therefore, our first studies investigated how infants determine which plants can be eaten (Wertz & Wynn, 2014a). Given that plants do not reliably signal human-relevant edibility or toxicity, combined with the high costs of trial and error learning, we predicted that human infants would rely on social information to determine plant edibility. Further, we predicted that such learning processes would be selective, such that the same social cues of edibility would be interpreted differently for plants than for other types of entities.

To test this, we showed 18-month-old infants events in which an adult actor demonstrated the same social cue of edibility with a plant and an artifact (see Figure 10), in a counterbalanced order. The actor picked a piece of fruit off the plant (or the artifact) and put it in his mouth while saying, "Hmmm." Then he performed the same action with the other stimulus object. Finally, he removed the remaining fruits from each stimulus object and placed them on a board. A second experimenter offered infants the board and asked

### Key Reference

**Wertz, A. E., & Wynn, K.** (2014a). Selective social learning of plant edibility in 6- and 18-month-old infants. *Psychological Science*, 24, 874–882. doi:10.1177/0956797613516145



*Figure 10.* Plant and novel artifact stimuli used in the edibility experiments of Wertz and Wynn (2014a). The fruit color paired with the plant and artifact were counterbalanced across infants such that half of the infants saw the stimulus configuration depicted in the top row, while the other half saw the configuration in the bottom row.

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*"Which one can you eat?"* Infants' choices were recorded.

Despite seeing exactly the same action performed with both object types, infants reliably selected fruits from the plant over fruits from the artifact. Control conditions confirmed that infants also selected the plant as edible when it was contrasted with a more familiar object—a shelf containing fruits and other objects. However, infants chose equally between the plant and artifact when the actor demonstrated a different nonfood relevant action or no action at all, suggesting that plant selectivity is limited to socially conveyed edibility information in these experiments (see Figure 11). These results indicate that, as predicted, 18-month-olds selectively use social cues to identify edible plants. We ran a similar experiment with 6-month-old infants, who have far less experience with solid food items and found converging results.

Instead of asking infants to make a choice, we measured the time they spent looking at different types of events. We used a violation-of-expectation paradigm in which infants look longer at events that do not match their underlying expectations. In this case, as predicted, infants looked longer when the actor placed fruits from artifacts in his mouth than fruits from plants, indicating that 6-month-olds expected the actor to eat parts of plants, but not parts of artifacts.

Taken together, these results indicate that infants at both 6 and 18 months of age are sensitive to social information about plant edibility. Further, the findings suggest that human food learning systems are sensitive both to the particular social information conveyed and the type of entity being acted upon.

In a separate set of studies currently under review, we explored the social aspect of ed-

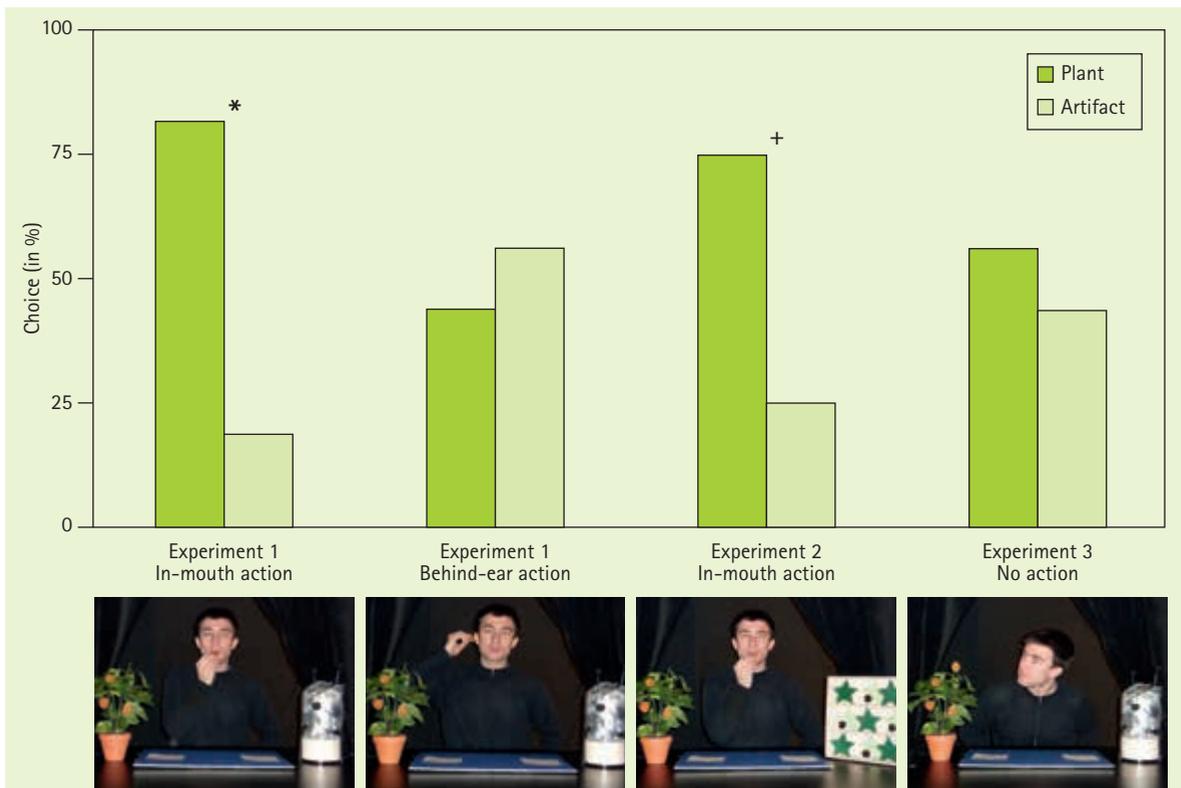


Figure 11. Eighteen-month-olds' choice behavior. When the actor demonstrated eating both object types, infants reliably chose the plant as edible over both novel and familiar objects (Experiments 1 and 2, in-mouth action). In control conditions (Experiments 1 and 3, behind-ear and no action), infants chose randomly, demonstrating that plant selectivity was specific to inferences about edibility in this experiment. \* binomial  $p < 0.05$ , two-tailed; + binomial  $p < 0.05$ , one-tailed (adapted from Wertz & Wynn, 2014a).

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ibility learning further by testing what kinds of social signals infants use to infer plant edibility and whether infants systematically extend edibility inferences to similar looking plants. The results of these studies suggest that 18-month-olds infer plant edibility based on cues of consumption and offering, but not based on more general cues of physical contact. Importantly, these results show that infants do systematically generalize edibility information. That is, when infants watch an adult eat from one plant, they recognize that other similar-looking plants are also edible. To our knowledge, this is the first demonstration that infants at this age systematically generalize edibility information.

### How is Socially Learned Information Extended to Other Entities?

Generalizing one instance of social learning to a broader array of entities requires that infants recognize two entities as members of the same category. However, the processes infants use to categorize plants—and thereby appropriately extend socially learned information about edibility or danger beyond

the single initial social event—remain unknown. We have two ongoing projects in the Institute's BabyLab exploring this question. The first project is investigating the visual features infants use to distinguish plants from other types of objects using closely matched images of plants and other entities (see Figure 12). The second project seeks to uncover the features infants use to distinguish one type of plant from another. Both projects employ infant eye-tracking methodologies to provide detailed information about infants' visual attention processes during categorization tasks (see Box 1, Figure 1).

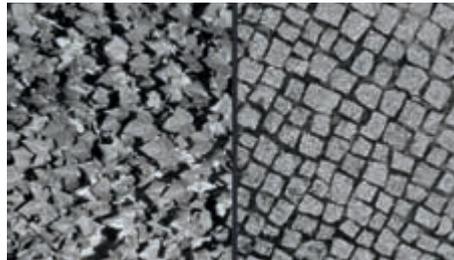


Figure 12. Example stimuli contrasting plant and non-plant images.

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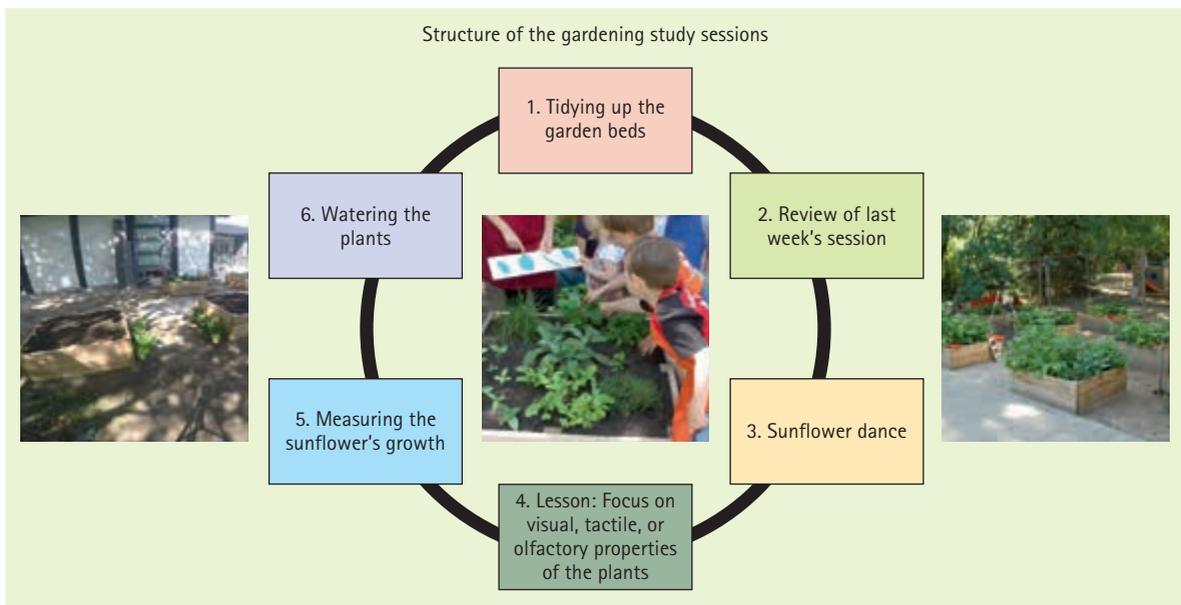
## Research Area 3: Learning in the Wild

The goal of this third line of research is to broaden the scope of our investigations. We are doing this in three ways: First, we have begun a line of research that takes our studies out of a laboratory setting and into the garden, with the aim of understanding how the behavioral avoidance strategies and social learning processes we identified in the laboratory unfold in more naturalistic settings. Second, we have begun a collaborative project to investigate infants' and young children's responses to plants cross-culturally. Third, in collaboration with comparative psychologists, we have begun to explore how nonhuman primate species interact with plants.

### Learning in the Garden

In 2016, we completed the first year of a planned three-year longitudinal study examining how children from 1 to 6 years of age learn about plants and retain that information over time. To do this, our research group designed and implemented a gardening program for young children that begins with children planting seeds and seedlings and then caring for the plants as they grow for 8 weeks. Throughout this time, the children engage in weekly gardening sessions with members

of our research team which focus on different features of the plants (see Figure 13). Children's knowledge about the plants is assessed before and after each year's gardening program with a series of standardized tasks, and their behavior during the gardening sessions is coded from videos of the sessions (see Box 1, Figure 3). This study is being carried out at the Institute's affiliated Forschungskindertagesstätte "Kinderbetreuung Lützelsteiner Weg e.V." We look forward to continuing this gardening program in 2017 and 2018.



*Figure 13.* Structure of the gardening sessions in our longitudinal gardening program. Each session begins with an introductory activity to tidy up the gardening beds and a review of the previous week's session. Next, the children do a "sunflower dance" that relates plant parts to parts of their body to facilitate their engagement with the plants. This is followed by a lesson that focuses on one particular feature of the plants: leaf shape, leaf texture, or olfactory properties. Then, children measure the height of the sunflower and mark its progress for that week on a growth chart. The session ends with a closing activity of watering the plants.

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### Budding Knowledge

A second ongoing project examines dyadic parent-child interactions around plants in a naturalistic environment. In this observational study, we are inviting parents and children to the Institute's garden and then asking parents to show their children several different plants in whichever way they choose (see Figure 14). We record the interactions on video to examine what kinds of behaviors parents and children exhibit when they explore plants together and what types of information they share with one another. Preliminary analyses of these videos have yielded important insights. For example, observing parents and children in this naturalistic setting revealed a prominent role for olfactory cues in parent-child communication about plants.

### Cross-Cultural Investigations

In the summer of 2016, we collaborated with anthropologists from the University of California, Los Angeles (UCLA), lead by Dr. H. Clark Barrett, to conduct a study among the Shuar, a group of hunter-horticulturalists living in



*Figure 14.* Parent and child exploring a fennel plant together in the Institute's garden.

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Figure 15. A Shuar infant participating in our social referencing study.

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the Amazon basin in Ecuador. Shuar infants and young children participated in a version of our social referencing study to examine their responses to plants. The Shuar culture provides an informative comparison with the cultures in which we have run our previous studies: a small city on the east coast of the United States and a large urban area in Germany. In contrast to children living in those areas, Shuar children grow up fully immersed in the natural world. They have much richer first-hand contact with plants, both with the cultivated plants growing around their homes and the wild plants in the jungle, and they learn about plants from adults who have extensive expertise about the local flora. The research team from UCLA presented Shuar children with the same types of stimulus objects we used in our social referencing study: real plants, artificial plants, novel artifacts, familiar artifacts, and naturally occurring objects (see Figure 15). Data coding is currently underway to assess Shuar infants' and young children's behavioral avoidance and social information seeking strategies for plants compared to other object types. Our goal is to determine whether Shuar children behave similarly to, or differently from, the infants we have tested in the United States and Germany. We plan to expand this project in the future to include a wider array of cultures.

### Comparative Studies

In an ongoing collaboration with comparative psychologists at Yale University, we collected data from two different nonhuman primate species to investigate how species with

different evolutionary histories and natural ecologies interact with plants. These studies examine nonhuman primates' responses to plants compared to other object types. Our first data set from adult capuchin monkeys indicates that, like human infants, this species treats plants differently from artifacts and other naturally occurring objects, but the capuchins show a different pattern of response. Specifically, capuchins were *faster* to touch plants than the other object types we tested. This type of response is consistent with the different types of interactions that capuchins have with plants, both phylogenetically and ontogenetically, than human infants. To further explore the source of these cross-species differences, the Yale research team tested a second nonhuman primate species—rhesus macaques—in the summer of 2016 using the same stimulus object types. The responses from both juvenile and adult rhesus macaques are currently being coded to test whether this species behaves more similarly to capuchins or human infants, and whether rhesus macaques' responses to plants differ across development.

### Additional Research Projects: Exploring Cognitive Development in Infancy

In addition to our primary research program, we conduct studies investigating other areas of cognitive development in infancy. The goal of these studies is to investigate core aspects of cognitive architecture that infants use to make sense of their physical and social worlds and to test whether these foundational cognitive abilities persist from infancy into adulthood. These projects examine whether

cognitive and perceptual systems in infancy are sensitive to certain regularities in the world, such as the correlation between the pitch of sounds and the size of organisms making those sounds (Pietraszewski, Wertz, Bryant, & Wynn, in press), and the constraints that Newtonian physics places on the movement of physical objects. For example, data collected in part in the Institute's BabyLab indicates that 7- and 9-month-old infants are sensitive to a Newtonian "speed limit" on the behavior of objects in collision events (Kominsky, Strickland, Wertz, Elsner, Keil, & Wynn, in press). That is, when one object collides with another, the second object cannot move away faster than twice the first object's speed. The collaborative project exploring sensitivity to this Newtonian principle across development includes researchers from Yale University and the Jean Nicod Institute in Paris. Our results suggest that preverbal infants are sensitive to this principle and that the sensitivity to violations of this principle is preserved into adulthood. The paper for this project is currently under review.

### Summary and Future Directions

The research carried out by members of the Max Planck Research Group "Naturalistic Social Cognition" has uncovered previously unknown behavioral avoidance strategies and selective social learning mechanisms in human infants. When confronted with plants, infants minimize physical contact with them, differentially seek out social information, and selectively learn certain types of information (i.e., edibility). These findings are consistent with our proposal that aspects of human cognitive architecture reflect the recurrent interactions that humans have had with plants over evolutionary time, resulting in a social learning system tailored to acquiring information about plants over the course of ontogeny. Our ongoing work is continuing to interrogate this proposal and broaden the scope of our investigations to include naturalistic settings, different cultures, and different species.

## Publications 2014–2016

(last update: Spring 2017)

Adam, M., Reitenbach, I., Papenheimer, F., Gredebäck, G., **Elsner, C.**, & Elsner, B. (2016). Goal saliency boosts infants' action prediction for human manual actions, but not for mechanical claws. *Infant Behavior and Development*, 44, 29–37. doi:10.1016/j.infbeh.2016.05.001

**Fantasia, V.**, Markova, G., Fasulo, A., Costall, A., & Reddy, V. (2016). Not just being lifted: Infants are sensitive to delay during a pick-up routine. *Frontiers in Psychology*, 6:2065. doi:10.3389/fpsyg.2015.02065

Kominsky, J. F., Strickland, B., **Wertz, A. E.**, **Elsner, C.**, Keil, F. C., & Wynn, K. (in press). Categories and constraints on casual perception. *Psychological Science*.

**Pietraszewski, D.**, **Wertz, A. E.**, Bryant, G. A., & Wynn, K. (in press). Three-month-old human infants use vocal cues of body size. *Proceedings of the Royal Society B, Biological Sciences*.

**Wertz, A. E.**, & Wynn, K. (2014a). Selective social learning of plant edibility in 6- and 18-month-old infants. *Psychological Science*, 25, 874–882. doi:10.1177/0956797613516145

**Wertz, A. E.**, & Wynn, K. (2014b). Thyme to touch: Infants possess strategies that protect them from dangers posed by plants. *Cognition*, 130, 44–49. doi:10.1016/j.cognition.2013.09.002

# Max Planck Research Group

Reading Education and  
Development (REaD)

Head: *Sascha Schroeder*



#### Research Team 2014–2016

Caroline Cohrdes (until 12/2016), Wibke Hachmann, Jana Hasenäcker, Petroula Mousikou, **Sascha Schroeder**, Simon P. Tiffin-Richards

#### *Predoctoral Fellows*

Sarah Eilers, Lorenz Grolig, Stefan HeB (LIFE), Alexandra Schmitterer (until 10/2016), Pauline Schröter (as of 08/2016: Institute for Educational Quality Improvement [IBQ], Berlin, Germany), Jutta Segbers (as of 09/2016: University of Münster, Germany)

## Introductory Overview

The Max Planck Research Group “Reading Education and Development” (REaD) investigates the underlying structure of reading skills and their development across the lifespan. To this end, the Research Group assesses the component processes of reading longitudinally and analyzes their interactions. This approach will allow the researchers to provide a more detailed description of the various subprocesses of reading and to analyze their conditions and consequences. These insights, in turn, will enable the Research Group to identify the processes that should be targeted by effective remedial programs in reading education.

Reading is one of the most important, but also one of the most complex, inventions in human history. In our information-oriented society, it is vital to be able to read texts accurately and efficiently. People who lack these skills are at a serious risk of marginalization: Adults with functional illiteracy often find themselves socially isolated; adolescents who are unable to write a letter of application fail to find a job.

In contrast to learning to talk, children do not learn to read spontaneously, but need instructional help and support. Yet many children have problems with reading acquisition and remain unable to understand even simple texts by the end of their compulsory education. How can we help these children?

Reading is a cognitive skill that involves a number of interacting processes located at different levels within a general hierarchy. It is unclear which are important for children’s reading development and how they interact. Furthermore, it is likely that children with reading difficulties have different types of deficits and need different kinds of support.

The Max Planck Research Group REaD was launched in summer 2012 with the aim of investigating the underlying structure of reading skills and their development over childhood and adolescence. To this end, we assess the processes that underpin reading and analyze their interactions at different stages of reading development. This approach will provide a more detailed description of the various components of the reading system and their role in reading development. These insights, in turn, will enable us to identify the processes to be targeted by effective intervention programs in reading education.

A distinctive characteristic of the REaD group is that it takes an integrative approach to the investigation of reading: Theoretically, we combine elements from linguistics, psychology, and education. Empirically, we investigate the reading process as a whole—from reading single words to processes on the text level. Methodologically, we combine cross-sectional and longitudinal designs as well as corpus studies and experimental paradigms from cognitive psychology.



*Figure 1.* The acquisition of linguistic abilities before school is important for later reading development.

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Figure 2. Most processes involved in reading are influenced by the amount of children's reading behavior.

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The research agenda of the REaD group is structured around four main projects:

- (1) In the *childLex* project, we have established a linguistic corpus of German-language writing for children. It is complemented by the *InLex* project, which investigates interindividual differences in the mental lexicon of children in different age groups. Establishing such norms is essential for the design of experimental studies and training programs.
- (2) In the *DeveL* project, we are collecting behavioral data for a selected set of words from participants across the complete lifespan. These data are critical for the development of the next generation of computational models of visual word recognition.
- (3) The *DevTrack Study* investigates reading processes using eye-tracking techniques. This approach allows us to analyze children's reading of connected text during natural reading.
- (4) Two interconnected longitudinal studies investigate interindividual differences in reading development. The *OPeRA* project focuses on children's use of different orthographic grain sizes during reading development in school. The complementary *PLAiT* project concentrates on the transition from kindergarten to grade 1.

Furthermore, we were able to obtain external funding for three additional projects that extend the research agenda of the group. This includes the *MusiCo*, which investigates the effects of musical training in kindergarten on children's later reading; *ERIC*, which focuses on the effects of teachers' classroom activities on children's reading processes; and *Morpheme*, which explores children's morphological development in German and French.



Figure 3. *childLex* comprises 500 children's books.

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## childLex: A Corpus of German–Language Writing for Children

*childLex* is a linguistic corpus that has been collected from a large number of children's books in order to investigate German–language writing for children. The complementary *InLex* project focuses on interindividual differences in the structure of children's mental lexicon.

Linguistic databases for children are important tools for developmental studies of reading and to select stimulus materials for experimental studies and for investigating children's written and spoken language skills. For adults, a wide selection of corpora is now available, but these databases may not be adequate for children.

In order to account for potential differences between adults and children, specialized corpora for children have been collected in some languages (e.g., English, French, Spanish, Italian). For German, however, there was previously no electronic database of materials intended to be read by children. To fill this gap, we have compiled the *childLex* corpus to investigate German–language writing for children and to establish an online database that gives users access to a wide selection of linguistic variables.

*childLex* provides separate norms for children aged in grades 1 to 2, grades 3 to 4, and grades 5 to 6. It is based on 500 books that vary widely in terms of length and content.

In order to maximize the number of words in each age group, we oversampled books for beginning readers. Books were scanned manually, converted into text, and annotated using several algorithms: First, the text was divided into distinct words (tokenization). Next, the base form of each word was determined (lemmatization). Finally, words were assigned a syntactic category (noun, etc.). *childLex* comprises approximately 10 million words (tokens). These are distributed over 170,000 types (distinct word forms and 110,000 lemmas (base forms). We distinguish between variables at the lexical (e.g., frequency, length, neighborhood size) and sublexical level (e.g., letter and syllable characteristics).

Detailed descriptions of the *childLex* database have been published in both international (Schroeder, Würzner, Heister, Geyken, & Kliegl, 2015a) and national (Schroeder, Würzner, Heister, Geyken, & Kliegl, 2015b) journals. An online version of the database is available to the scientific community on [www.childlex.de](http://www.childlex.de). In addition, we have investigated differences

### Key References

Schroeder, S., Würzner, K.-M., Heister, J., Geyken, A., & Kliegl, R. (2015a). *childLex*: A lexical database of German read by children. *Behavior Research Methods*, 47, 1085–1094. doi:10.3758/s13428-014-0528-1

Schroeder, S., Würzner, K.-M., Heister, J., Geyken, A., & Kliegl, R. (2015b). *childLex*: Eine lexikalische Datenbank zur Schriftsprache für Kinder im Deutschen. *Psychologische Rundschau*, 66, 155–165. doi:10.1026/0033-3042/a000275

### Are "Child" and "Adult" Words Processed Differently by Children and Adults?

Do the differences in children's and adults' linguistic input affect their behavior in visual word recognition tasks? To investigate this issue, we chose 20 "child" words (that are frequent in *childLex*, but infrequent in a corpus for adults; e.g., "pirate," "fairy") and 20 "adult" words (that are frequent in an adult corpus, but not in *childLex*; e.g., "tax," "culture"). Four age groups (children, adolescents, younger adults, older adults) performed a lexical decision task using these words. Their response accuracies are shown in Figure 4: Children showed a processing advantage for child words; adolescents performed similarly on both types of words; and adults showed a processing advantage for adult words.

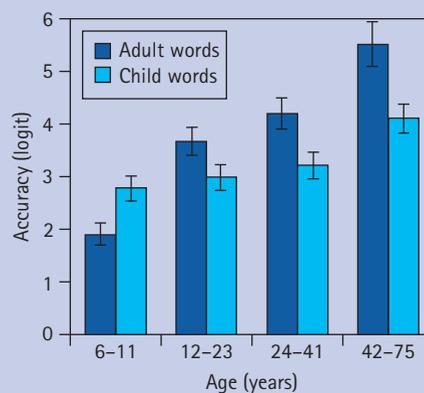


Figure 4. Response accuracy for "child" and "adult" words in different age groups.

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Box 1.

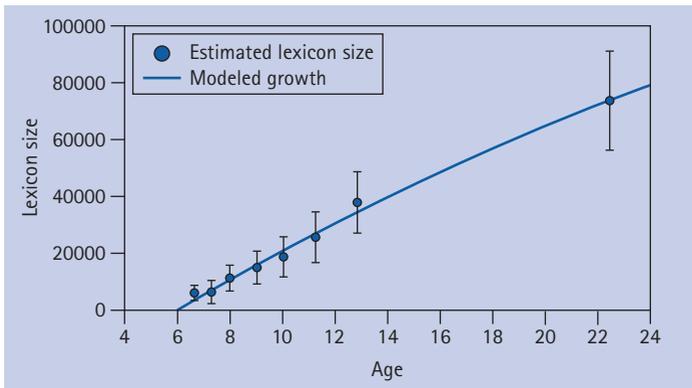


Figure 5. Development of lexicon size by age (adapted from Segbers & Schroeder, 2016).

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in the print environment of different age groups (Würzner, Heister, & Schroeder, 2014) and the distribution of phonological and morphological categories within the corpus (Würzner & Schroeder, 2015). Further analyses will focus on linguistic questions, such as determining the variables that influence lexical development during childhood, as well as more applied issues, such as how to assign text difficulty levels to books.

### InLex: The Individual Lexicon in Reading Acquisition

How many words does a child read? How many words are stored in his or her mental lexicon? What do these lexical representations contain and how are they connected? The *InLex* project addressed these issues and their impact on children's word recognition.

The mental lexicon can be regarded as a "word storage" which comprises information about all known words. It includes lexical characteristics, such as the number of known words (lexicon size), how often they have been encountered (frequency), and the number of similar words that exist in the language (neighbors). Since language development is modulated by several internal and external factors, individuals differ in the size and content of their mental lexicon. Interindividual differences in the composition of the mental lexicon could be responsible for differences in the visual word recognition process. The aims of the *InLex* project were (1) to develop a method to estimate individual lexical characteristics and (2) to describe their development as well as their effect on visual word recognition. The underlying rationale of the project was to use a sampling approach using the *childLex* corpus. Using this method, we were able to determine how many words children with varying reading input sizes know (see Figure 5; Segbers & Schroeder, 2016). Using this method, we were also able to estimate how often a specific word has been encountered by children who differ in their reading input size. Such differences in "individual frequencies" are able to account for a large proportion of developmental differences in children's reading development. Figure 6 shows the effect of the new individual frequency measure, which indicates that the different age groups constitute different parts of one underlying developmental curve.

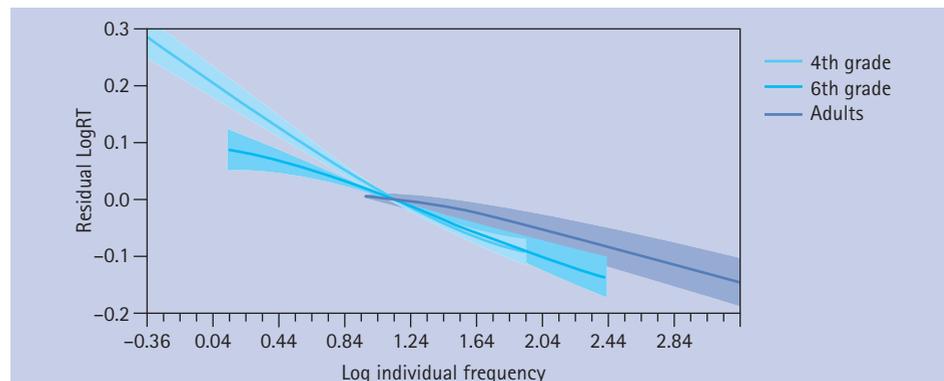


Figure 6. The effect of individual frequency in the three age groups combined.

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## DeveL: The Developmental Lexicon Project

The *Developmental Lexicon Project (DeveL)* investigates how visual word recognition processes change during reading development and across the lifespan. These data will be used to extend existing computational models of visual word recognition.

The process of word recognition, in which print is converted into linguistic information, is fundamental for reading. The impact of most word characteristics (length, frequency, etc.) on this decoding process is likely to change over time. However, none of the current models of visual word recognition explicitly includes a developmental dimension. One reason is that few studies have systematically compared the impact of linguistic variables on word processing across different age groups. For example, the *English Lexicon Project*, which was a multiuniversity effort to provide a database for the processing of 50,000 English words, investigated only adult readers. The aim of the *DeveL* project is to provide the first database on word recognition in German.

To this end, we selected 1,152 German words covering a broad range of linguistic characteristics that are considered crucial in developmental theories of written language acquisition. In a cross-sectional study, these words were presented to participants of different age groups, including children at different stages of reading development, younger adults, and older adults. Overall, data from 430 children in grades 1–6 were collected in computerized single sessions. In addition, younger (20–30 years old) and older adults' (65–75 years old) performance for the same words was assessed. Word recognition performance was measured using lexical decision and naming paradigms, which are commonly used in psycholinguistic research to assess lexical processing. To further inves-

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Schröter, P., & Schroeder, S. (2017). The developmental lexicon project: A behavioural database to investigate visual word recognition across the lifespan. *Behavior Research Methods*. Advance online publication. doi:10.3758/s13428-016-0851-9

Hasenäcker, J., Schröter, P., & Schroeder, S. (2017). Investigating developmental trajectories of morphemes as reading units in German. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. Advance online publication. doi:10.1037/xlm0000353

### The Dual-Route Model of Visual Word Recognition

A widely accepted computational model of visual word recognition is the Dual-Route Model. It postulates two ways by which print can be converted into meaning (see Figure 7). First, words can be decoded via a sublexical route using grapheme–phoneme rules that are applied serially from left to right, letter by letter. Second, words can be processed via a lexical route. Here, the meaning and pronunciation of a word as a whole are retrieved from its representation in the mental lexicon. This process is assumed to happen quickly and in parallel.

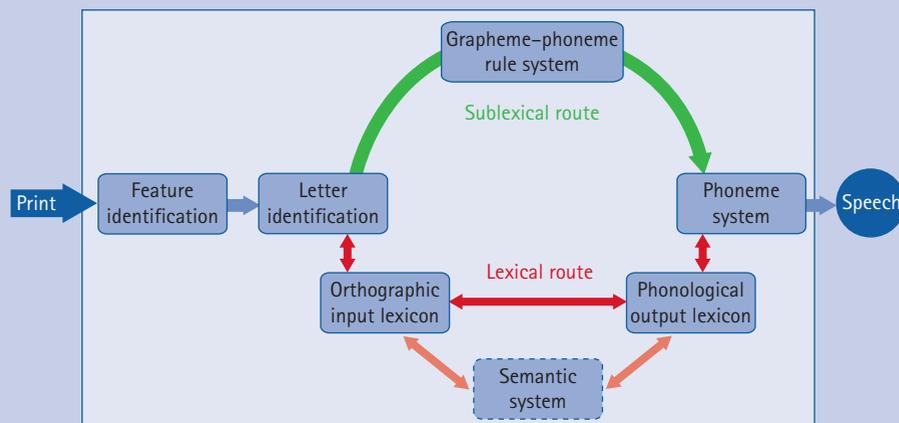


Figure 7. The Dual-Route Model of visual word recognition.

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Box 2.

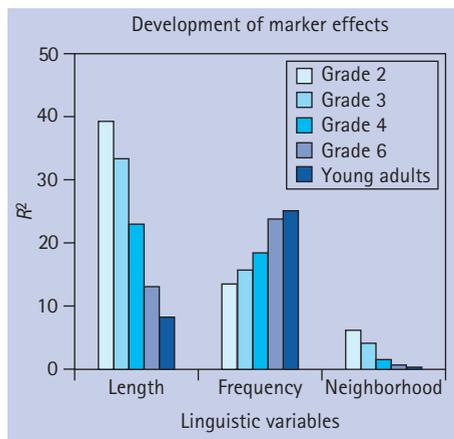


Figure 8. Percentage of variance accounted for by word length, word frequency, and orthographic similarity in the *DeveL* project.

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to investigate the impact of different reader variables on processing, we implemented measures of reading speed, vocabulary knowledge, and nonverbal intelligence. The three main aims of this project are to identify: (1) which linguistic features affect word recognition processes in German, (2) how their influence changes over time, and (3) whether the observed developmental patterns show interindividual differences.

The data of the *DeveL* project have been made available to the scientific community (Schröter & Schroeder, 2017) with the aim of helping researchers to advance theories and computational models of visual word recogni-

tion that include a developmental perspective. In addition, these data can be used to investigate the development of linguistic marker effects on the lexical level.

For example, we analyzed the correlations between three important linguistic marker effects—word length, word frequency, and neighborhood size—and participants' response behavior in different age groups (Schröter & Schroeder, 2017). Figure 8 shows the amount of explained variance ( $R^2 \times 100$ ) that was explained by these three variables in children's (grades 2–6) and young adults' response latencies.

Results show that children's responses at the beginning of reading instruction were heavily affected by word length, which predicted about 40% of the variance. This percentage decreased steadily during development to a value of about 8% in younger adults. Orthographic neighborhood size showed a similar developmental trend, but to a smaller extent. By contrast, correlations with word frequency showed an increasing developmental pattern from about 13% in grade 2 to 25% in young adults. This demonstrates that orthographic and lexical information is used differently by children and by adults.

In another analysis of the *DeveL* data, we investigated processing differences between multimorphemic words (compounds *cook+book*, prefixes *un+learn*, and suffixes *read+able*) and monomorphemic words (*pencil*; Hasenäcker, Schröter, & Schroeder, 2017). This is of great interest because the vast majority of German words are multimorphemic. Results indicate that morphological structure is helpful for fast and efficient word recognition even for beginning readers and there is a specific developmental pattern (see Figure 9): Compounds are read faster than monomorphemic words in grade 2, while suffixed and prefixed words are read faster than monomorphemic words in grades 3 and 4, respectively. This contradicts the common assumption that words with different morphological properties have the same developmental trajectory and it shows that reading instruction should take specific morphological structures into account to optimally support children at different reading levels.

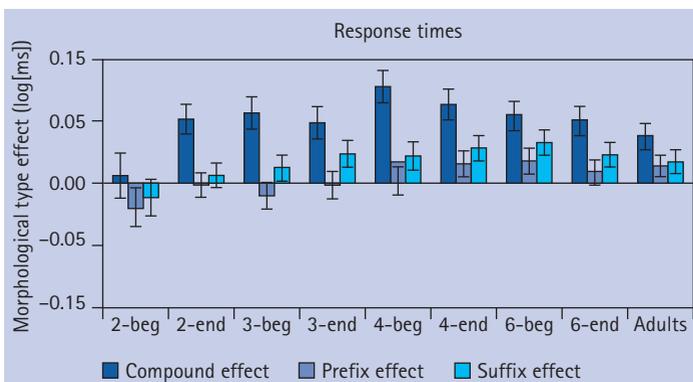


Figure 9. Compound, prefix, and suffix effects (differences between multimorphemic and monomorphemic words) for readers in different age groups (adapted from Hasenäcker, Schröter, & Schroeder, 2017).

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## DevTrack: The Developmental Eye-Tracking Study

Reading is more than decoding single words. With the *Developmental Eye-Tracking Study (DevTrack)* we aim to add depth to our understanding of children's natural reading processes by tracking their eye movements as they read sentences and texts.

Eye movements have long been used to track cognitive processes during complex tasks, such as visual search, scene perception, and reading. The eye-tracking research of the early 20th century established much of what we know today about typical eye movements; for instance, that the eyes move in a series of jumps (saccades) and pauses (fixations) and that information is processed only during fixation periods. During reading, adult eye movements generally consist of saccades of 7 to 9 characters and fixations of 200 to 250 milliseconds. The characteristics of eye movements are also subject to developmental changes, however, and the efficiency of eye movements during reading is thought to be strongly related to reading skill (Schroeder, Hyönä, & Liversedge, 2015). Skilled adult readers generally make long saccades, fixate words longer, and skip predictable words. We know that the eye movements of skilled adult readers and beginning readers differ substantially. We also know that individuals differ in their reading skill. Longitudinal designs, as employed in *DevTrack*, are therefore vital to capture both individual differences in the reading skill of beginning readers and the development of reading skill over time. *DevTrack* will be one of very few longitudinal studies that have attempted to tease apart the individual and developmental aspects of reading acquisition at the German elementary school level. Two mechanisms are known to drive the efficiency and development of eye movements. Foveal reading processes are involved when a word is focused directly; parafoveal processes are relevant when information about letters and words to the right of the fovea is extracted. In *DevTrack*, we investigated the development of these processes.

### Foveal Processes in Reading

In a study focusing on the foveal processes of beginning readers in grade 2, we investigated the effects of word length and frequency on

children's fixation durations, landing positions, and refixation rates (Tiffin-Richards & Schroeder, 2015a). Children read sentences with embedded target words in an experimental design in which word length and frequency were manipulated independently of one another. We found significant effects of word length and frequency for both children and adults while effects were generally greater for children. Our results illustrated in Figure 10 also show that children in grade 2 typically fixated both long and short words multiple times, whereas adults tended to fixate each word only once. Adults' refixation probability was only high when they first landed on the first or second letter in a long word, while children refixated long words regardless of where their first fixation landed. This suggests that children's default reading strategy involves fixating long words multiple times, presumably because single fixations are insufficient for full lexical processing.

### Parafoveal Processes in Reading

In another study (Tiffin-Richards & Schroeder, 2015b), we investigated how children's processing of information in the parafovea

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Tiffin-Richards, S. P., & Schroeder, S. (2015a). Word length and frequency effects on children's eye movements during silent reading. *Vision Research, 113*, 33–43. doi:10.1016/j.visres.2015.05.008

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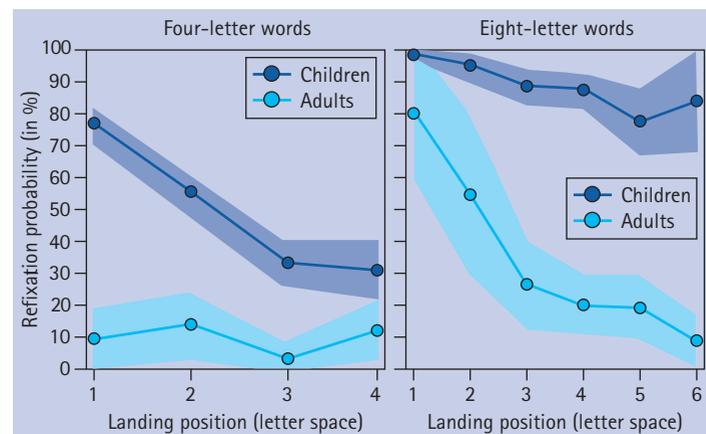


Figure 10. Children's and adults' refixation probability for short and long words as a function of their initial landing position (adapted from Tiffin-Richards & Schroeder, 2015a).

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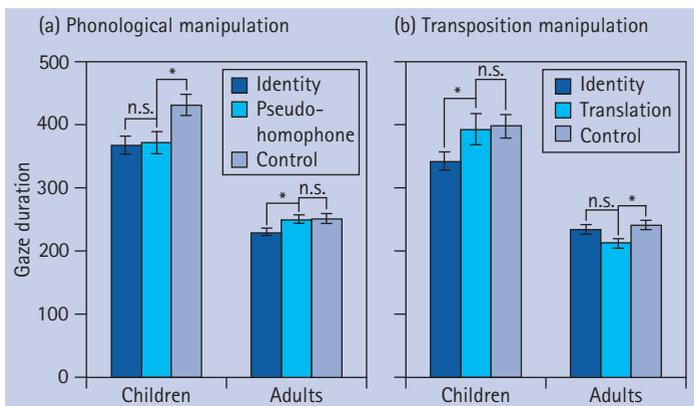


Figure 11. Findings on the parafoveal preview benefit.

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changes during reading development. Studies have found that adults extract specific word information (e.g., orthographical and phonological) from the parafovea. This information can then be integrated when the word is fixated foveally, facilitating the word recognition process. The quantity and type of information that can be processed parafoveally by beginning readers remains unclear, however. This question can be addressed using the boundary paradigm illustrated in Box 3. We concentrated on two marker effects that show differences in developmental reading: phonological and orthographic preview benefits. In order to test phonological preview benefits, either a nonword that is pronounced similarly to the target word (e.g., "clew" for the target word "clue") or an orthographically matched control word (e.g., "clon") is

shown in the parafovea. If the target word is processed faster in the pseudohomophone condition than in the control condition, this indicates that phonological information has been accessed. By a similar logic, transposition preview effects can be used to quantify the amount of orthographic processing in the parafovea. As orthographic processing becomes more parallel during reading development, the encoding of the exact position of a letter becomes less important, and words with transposed letters (e.g., "bnad") are frequently mistaken for the real word (e.g., "band"). Results indicate that children, but not adults, showed phonological preview benefit effects (see Figure 11). This suggests that children rely more on phonological decoding processes during parafoveal processing than adults. By contrast, adults, but not children, showed transposition preview benefit effects. This indicates that children do rely more on the exact position of letters within a word than adults. Taken together, both findings are consistent with a developmental trend from sublexical to lexical processing. In the main study of the *DevTrack* project, we investigated how foveal and parafoveal processes develop by following 100 children from grade 2 to grade 4. Data collection was completed in summer 2016. We are now preparing our first publications that will describe developmental changes in eye-movement behavior over the first years of elementary school and their relationship to other skills, such as lexical and oculomotor efficiency.

### Investigating Parafoveal Processing: The Boundary Paradigm

In the boundary paradigm, target words are presented as manipulated previews until the reader's eyes move to bring them into focus. When the first saccade on the target word is made, the preview ("clew") is exchanged with the target word ("clue"; see Figure 12). As the display change happens during the saccade onto the target word, the reader never actually sees the preview other than in his or her parafovea. By manipulating the preview, we can assess whether fixation durations on the target word differ, depending on whether the target word, or a similar sounding nonword, was present in the parafovea.

The detective found the | clew behind the sofa.  
 The detective found the | clue behind the sofa.

Figure 12. Preview and display change to target word after the reader's gaze crosses the invisible boundary.

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Box 3.

## Investigating Reading Longitudinally: OPeRA and PLAIiT

What are the developmental mechanisms underlying reading acquisition and which precursor abilities are needed? Two interconnected longitudinal studies initiated in 2013 will investigate the preconditions and consequences of children's initial reading ability.

The *OPeRA* project (*Orthographic Processing in Reading Acquisition*) focuses on children's use of different orthographic grain sizes during reading development in school from grade 1 to grade 4. The complementary *PLAIiT* project (*Prerequisite Language Abilities in the Transitional Phase*) concentrates on the transition from kindergarten to school and investigates which precursor abilities are linked to children's later reading acquisition. By using a similar theoretical framework and identical outcome measures, *OPeRA* and *PLAIiT* will be able to provide a unified picture of the processes needed in the initial steps of reading acquisition and their consequences for children's later development in school.

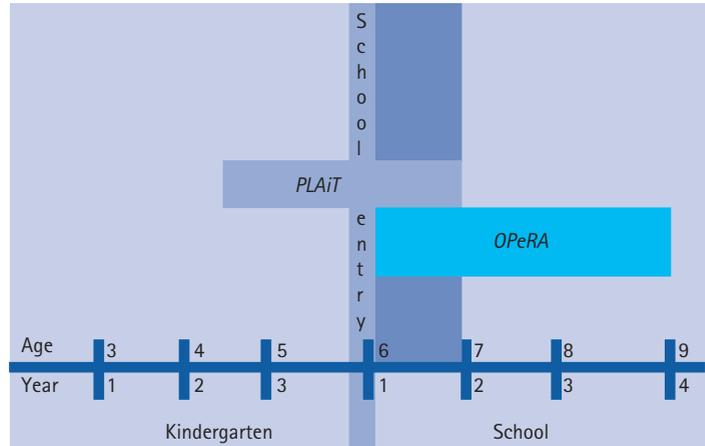


Figure 13. Time frame and overlap of the *PLAIiT* and *OPeRA* projects.

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### *OPeRA*: Orthographic Processing in Reading Acquisition

Orthographic processing operates using different units, such as letters, bigrams, syllables, or morphemes. Which grain sizes readers rely on is thought to vary across languages as well as individuals. In general, it is thought that beginning readers start with smaller grain sizes, such as single phonemes, and by means of chunking proceed to use increasingly bigger units, such as syllables or morphemes.

The *OPeRA* project aims to track the development of orthographic processing in German and to identify the grain sizes used by children at different developmental stages. To this end, we follow 120 students from Berlin elementary schools from grade 1 to grade 4. Data collection will be completed in 2017. A pilot study using the masked priming paradigm (Box 4) provided first insights into the use of morpho-orthographic repre-

cue (+, 500 ms)  
prime (TAECHER, 50 ms)  
mask (#####, 100 ms)  
target (TEACHER, 1,500 ms)

### The Masked Priming Paradigm

Masked priming is a well-established paradigm to investigate orthographic processing. Different manipulations of the prime can be used, for example, morpheme combinations or letter transpositions, to test the activation of the corresponding units (see Figure 14). Participants are required to decide whether or not the target is a word. The priming benefit relative to a control condition indicates which units are used.

Figure 14. Schematic depiction of the sequence of a trial in the masked priming paradigm.

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Box 4.

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Hasenäcker, J., Beyersmann, E., & Schroeder, S. (2016). Masked morphological priming in German-speaking adults and children: Evidence from response time distributions. *Frontiers in Psychology*, 7:929. doi:10.3389/fpsyg.2016.00929

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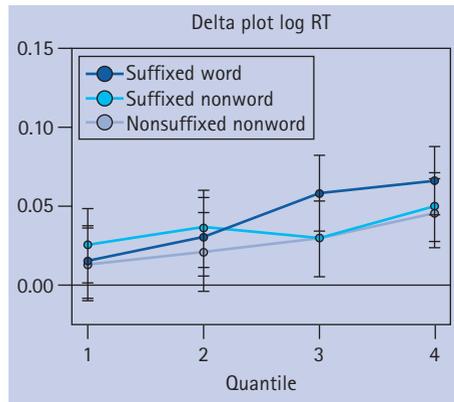


Figure 15. Morphological priming effects for children in different response time quantiles (adapted from Hasenäcker, Beyersmann, & Schroeder, 2016).

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sentations by children. Children activate orthographic representations of morphemes (*quick*), regardless of whether it is primed by a suffixed word (*quickly*), a suffixed nonword (*quickify*), or a nonsuffixed nonword (*quick-ach*). Moreover, analysis of the response time distribution partitioned into quantiles showed that the activation happens even in very fast response times (see Figure 15). This finding indicates the very early and automatic use of morphemes in the elementary school years. The results from the pilot studies and preliminary analyses of the longitudinal data from the *OPeRA* project offer important new insights into the developmental trajectories of the use of different reading units, especially graphemes, syllables, and morphemes. After

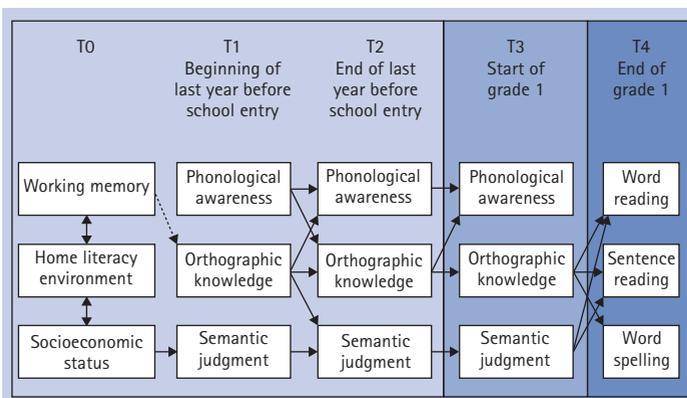


Figure 16. Relationship between linguistic variables and children's later reading ability.

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completion of the data collection in summer 2017, the longitudinal data set will be analyzed to examine precursor abilities and interindividual differences that influence the progress of the modes of processing in German reading acquisition. Several papers on the longitudinal perspective are planned to appear by the end of 2017.

### *PLAiT: Prerequisite Language Abilities in the Transitional Phase*

The longitudinal *PLAiT* project aims at filling the gap between language acquisition studies in early childhood and reading research at school age. *PLAiT* investigates the cognitive development of children in the transitional phase between kindergarten and school. This allows us to relate the development of orthographic representations to the general dynamics of language acquisition. In this project, the same group of children (ca.  $N = 90$ ) was tested every 6 months for two and a half years, from the 2nd year of kindergarten until the end of grade 1 of elementary school (age 4–7 years). At each measurement point, we assessed children's phonological, orthographic, and semantic abilities. Data collection was completed in summer 2016. At present, we are about to publish first results focusing on the predictive utility of different linguistic variables for children's later reading acquisition. For example, Figure 16 shows the contribution of children's phonological, orthographic, and semantic skills at different testing points to their ability to read and spell words and sentences in grade 1.

Results demonstrate that early orthographic knowledge is a key predictor for reading and spelling abilities at the end of grade 1. In particular, children's early phonological skills seem to facilitate the build-up of high-quality orthographic representations, which are in turn related to children's later reading ability. In further publications, we will zoom in on children's developmental trajectories in the phonological, orthographic, and semantic domains separately. Taken together, these results will allow us to provide a comprehensive picture of the children's lexical development and its connection to later reading acquisition.

## Externally Funded Projects

In the years 2014 to 2016, we were able to obtain external funding for several additional projects including the *MusiCo*, the *ERIC*, and the *Morpheme* project. Each project focuses on a different aspect of children's reading development and complements the core projects of the REAd group.

### MusiCo

*MusiCo* is a longitudinal project funded by the Rat für Kulturelle Bildung and the Stiftung Mercator (2014–2017). It investigates transfer effects of musical training on cognitive and reading development during the transition from preschool to primary school. Recent findings suggest that there is a positive relationship between diverse language and music skills. However, this evidence is largely correlational and does not allow causal interpretations. Experimental studies indicate transfer effects from musical training to specific language skills (e.g., phonological awareness), but evidence is still scarce and rather fragmented. *MusiCo* evaluates longitudinally a broad range of competencies from both language and music to determine the central variables that cause and explain transfer effects from one domain to another. In this study,  $N = 200$  children were assigned to three different groups in an experimental pre-post-follow-up design, including an intervention group (music training), an active control group (language training), and a passive control group (no specific training). Before and after the training, a wide range of experimental and standardized measures were used to assess different musical and

language processing skills. Results showed significant short-term transfer effects from one domain to another, both from pre- to postintervention as well as within-domain training effects. For example, children in the music training group showed an improvement in their phonological awareness comparable to the language training group (see Figure 17). In addition, children in the music training group showed a significantly higher increase in rhythm skills than both active and passive control groups. These findings suggest that music training supports the development of music skills and promotes the development of preliteracy skills as effectively as language training in preschool children.

Other analyses focus on the interrelationship between music and language skills on different hierarchical levels (Cohrdes, Grolig, & Schroeder, 2016) and how to assess print exposure in kindergarten children (Grolig, Cohrdes, & Schroeder, in press). Next, we will follow up all children after they enter primary school. This will allow us to investigate whether musical training in kindergarten also has long-term effects on children's early reading skills. Data collection is expected to be completed in summer 2017. First results will be published in 2018.

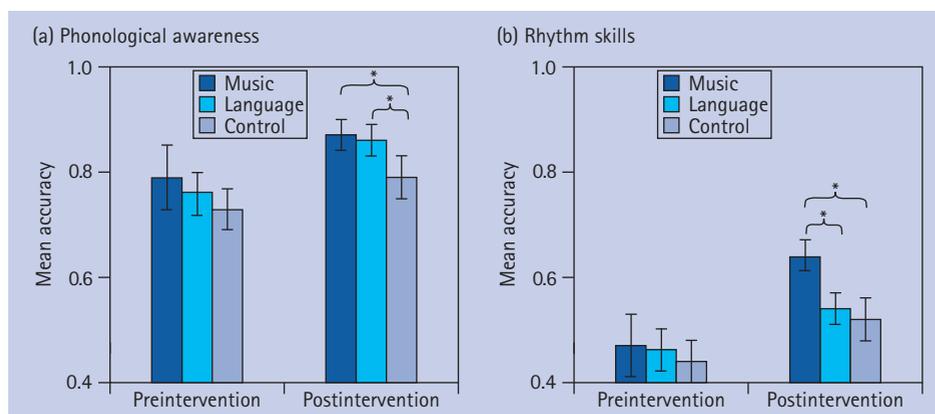


Figure 17. Pre- and posttest performance in language and music skills in the three experimental groups.

## ERIC

*ERIC* is a collaborative project between the MPRG REaD and the Institute for Educational Progress (IQB) and is funded by the German Ministry of Education and Research (2015–2017). The aim of the project is to model the cognitive processes that underlie reading performance in 4th-grade children and to investigate how different teaching methods influence the development of these underlying mechanisms. Thus, our goal is to provide an insight into the kinds of instruction that result in the most stable learning achievements in primary school children.

*ERIC* comprises a sample of 60 participating 4th-grade classes ( $N = 800$  children) recruited from several federal states. Students took part in a computer-based assessment of their reading processes (T1), which was repeated after 3 months (T2). At T2, students additionally took part in a national assessment encompassing the domains of reading comprehension, listening comprehension, and orthographic proficiency. At the same time, teachers of the participating classes provided evaluations of their students' proficiency in specific reading processes. Teachers also participated in an online logbook, describing their teaching techniques and the learning opportunities provided to their students over a 3-month period. These entries document

the amount of time dedicated to specific tasks and exercises, content and methods of German lessons, and an evaluation of the quality of tuition provided.

Data collection was completed in summer 2016. Results from the main study are expected to be published in 2017. However, results from an extensive pilot study ( $N = 200$ ) show that both spelling and reading comprehension performance are primarily determined by individual differences in the efficiency of lexical, word-level processes (see Figure 18). Lexical-level processes are, in turn, strongly influenced by the home literacy environment and word knowledge. These results emphasize the importance of reading opportunities for growing vocabulary size, which determines performance in the key literacy skills of reading comprehension and spelling.

Our findings demonstrate the importance of lexical processes for reading comprehension and spelling performance, which are primarily driven by reading experience and vocabulary knowledge. In subsequent analyses of the data collected during the main study, we will focus on integrating student performance, teachers' diagnostic competence, and the availability of learning opportunities. The goal of the study is to build a comprehensive picture of children's learning processes over the course of the final 6 months of the 4th grade.

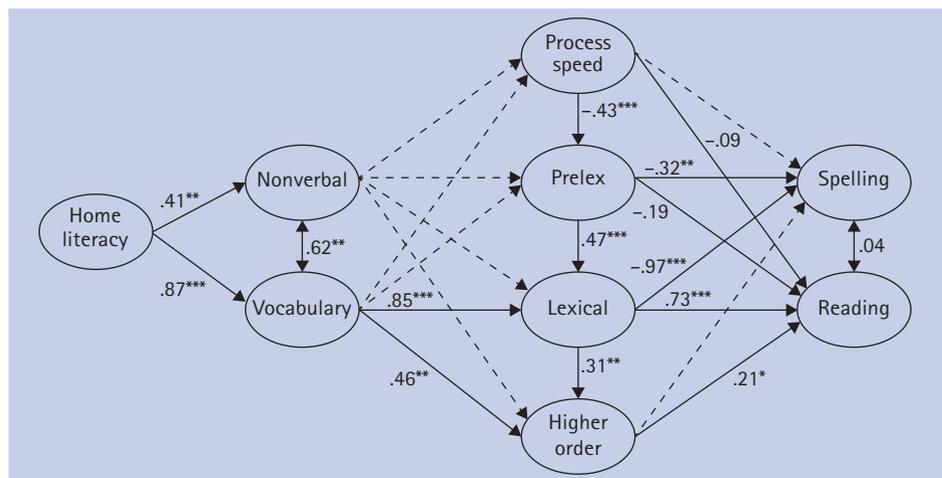


Figure 18. Relationship between reading on different hierarchical levels to children's reading and spellings skills.

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## Morpheme

*Morpheme* is a collaborative project between the MPRG REaD and the Laboratoire de Psychologie Cognitive at Aix-Marseille University, funded by a joint grant from the German and French Research Society (DFG-ANR, 2016–2018). This project investigates the development of reading skills longitudinally and cross-linguistically using a combination of methodologies from experimental cognitive psychology, computer science, and education. In particular, we seek to determine *how* and *when*, during reading development, morphological knowledge (knowing that “teacher” consists of two morphemes: the stem “teach” and the affix “er”) becomes incorporated into the French and German reading systems. Thus, our research aims to provide important insights into how language-specific characteristics may influence reading acquisition and development. The empirical data will also be used to evaluate and further develop extant theories of reading and their computational implementations.

*Morpheme* comprises a sample of 240 German and French children ( $N = 120$  in each country) in 2nd grade (T1), recruited from state schools in Berlin and Marseille. At T1 (winter 2017), which is currently in process, children perform several computer-based tasks that tap language and reading processes (e.g., aural and visual word recognition, reading aloud). Stimulus materials for these tasks were carefully constructed for cross-linguistic comparison. Children are further assessed on standardized tests that are typically used to measure general linguistic and cognitive processing skills. The same children will be followed up in a longitudinal fashion in 3rd and 4th grade and assessed on the same tasks. Data collection for T2 and T3 will take place in winter 2018 and 2019, respectively. German and French adult participants, who will serve as a control group, will also be tested on the same tasks.

Results from the main study are expected to be published in 2019 to 2020. However, preliminary findings from the German children at T1 suggest that children in 2nd grade are already able to decompose morphologically complex strings of sounds into their constituent morphemes. This was observed in an aural word recognition task (see Figure 19), where children were slower overall in recognizing a string of sounds as a nonword when it contained a stem (e.g., *teachness* or *teachnass*), compared to when it did not contain a stem (e.g., *teaphness* or *teaphnass*).

The goal of the *Morpheme* project is to investigate the processes that are involved when French and German children learn to read morphologically complex words, which comprise the vast majority of words in both languages. Thus, the findings from this project will offer the potential to develop new evidence-based programs of teaching instruction in both France and Germany. Our aim is to contribute to a wider conversation between academics and practitioners in the pursuit of developing a sound and effective literacy strategy in both countries.

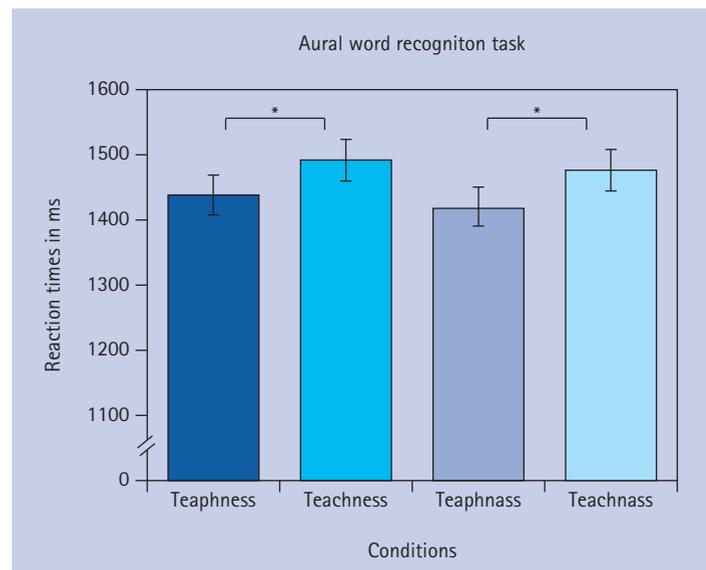


Figure 19. Results from the aural word recognition task in the *Morpheme* project.

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(last update: Spring 2017)

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# Max Planck Research Group

Affect Across the Lifespan  
(Concluding Report)

Head: *Michaela Riediger*



#### Research Team 2014

Antje Rauers (as of 09/2015: Freie Universität Berlin, Germany), **Michaela Riediger** (as of 06/2015: Heisenberg Research Group)

#### *Postdoctoral Fellows*

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#### *Predocctoral Fellow*

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#### *Visiting Researchers*

Michael Boiger (University of Leuven [KU Leuven], Belgium), Cornelia Wrzus (Johannes Gutenberg University Mainz, Germany)

## Introductory Overview

How do emotional experiences change from adolescence to old age? And how does the ability to understand and deal with affective experiences develop across the lifespan? These are questions that the Max Planck Research Group "Affect Across the Lifespan" investigated between 2009 and 2014. Unique features of the group's research approach involved the combination of a mobile-phone-based experience-sampling technology with psycho-physiological monitoring and controlled experimental paradigms, and the consideration that affective functioning takes place in, and is influenced by, the individual's social and ecological context. The group's work was characterized by two interrelated research emphases. A first emphasis on *affect dynamics* involved empirical investigations on age-related differences in the inner experiences, outward expressions, and physiological processes associated with affective experiences from adolescence to old age and on the mechanisms underlying these age-related differences, such as motivational and cognitive processes. A second research emphasis on *affective competencies* was characterized by empirical investigations on age-related differences in abilities related to understanding and managing emotional aspects of life.

### Research Emphasis 1: Age-Related Differences in Affect Dynamics

Investigations of affect dynamics involved various studies, age groups, and methodological approaches. Core research activities from 2014, the final year of the group's work, are summarized below.

#### The Multi-Method Ambulatory Assessment (MMAA) Project

The MMAA project is an ongoing longitudinal research endeavor in cooperation with Max Planck Research Fellow Gert G. Wagner. It has been continued after conclusion of the Max Planck Research Group "Affect Across the Lifespan" in the Heisenberg Research Group (see pp. 251–256). To date, the MMAA assessments include five measurement waves in a total sample of about 600 participants ranging in age from adolescence to old age. The main goal of this project is to chart various aspects of affective functioning and their interrelations with motivational and cognitive processes over time as they naturally occur in the daily lives and natural environments of individuals from various age groups. To meet this aim, several ambulatory assessment methodologies, which allow measurements of experiences, cognitive capacity, and physiological processes in daily-life contexts, are combined with interview techniques and well-controlled experimental paradigms. Ambulatory assessment methods include mobile-phone-based experience sampling and

ambulatory biomonitoring of cardiac activity (assessed via 24-hour electrocardiography), physical activity (assessed via 24-hour accelerometry), and hormonal processes (assessed via repeated ambulatory saliva samples). A comprehensive summary of all research activities within the MMAA project since 2014 is beyond the scope of this report. They have addressed, for example, age differences in everyday affect-regulation motivation (e.g., Riediger & Luong, 2016), mental representations of affect valence (e.g., Riediger, Wrzus, & Wagner, 2014), and affective and physiological reactivity and recovery from stressful events (e.g., Wrzus, Müller, Wagner, Lindenberg, & Riediger, 2014). Other analyses investigated age differences in associations between affective and physiological arousal and working-memory capacity (e.g., Riediger et al., 2014) or in associations between sleep quality and emotional well-being (e.g., Wrzus, Wagner, & Riediger, 2014). Below, we exemplarily illustrate research within the MMAA project in 2014 with the example of a recent publication in the *Journal of Social and Personality Psychology*.

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Riediger, M., & Luong, G. (2016). Happy to be unhappy? Pro- and contra-hedonic motivations from adolescence to old age. In A. D. Ong & C. E. Löckenhoff (Eds.), *Emotion, aging, and health* (pp. 97–118). Washington, DC: American Psychological Association.

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Wrzus, C., Wagner, G. G., & Riediger, M. (2016). Personality-situation transactions from adolescence to old age. *Journal of Personality and Social Psychology, 110*, 782–799. doi:10.1037/pspp0000054

### *Personality-Situation Transactions From Adolescence to Old Age*

It has been argued that people choose and create their daily environments, and thus shape their own developmental contexts, according to their personality. Prior research shows, for example, that more extraverted people engage more often in social situations and more conscientious people engage more often in work-related activities, compared to less extraverted or less conscientious people, respectively. So far, the knowledge about such personality-situation transactions largely stems from studies with students and young adults. Our aim was to go beyond that and investigate whether personality-situation transactions differ between individuals from various age groups. Based on the assumption of an age-related increase in knowledge about oneself, we expected individuals to increasingly select everyday situations in accordance with their personality as they get older. To explore this idea, we used data from the first assessment wave of the MMAA project where 378 people aged 14 to 82 years described their Big Five traits and took part in a 3-weeks-long experience-sampling phase. Up to 6 times a day for 9 days, on average, participants reported their momentary activity and who else was currently present. Multilevel modeling results in fact showed associations between participants' personality and their everyday life contexts and some of these personality-situation associations indeed varied with the age of participants. For example, associations between being extraverted and spending more time with friends were only observed in adolescents and young adults, whereas associations between being open to new experiences and spending more time with friends were only observed in older adults (see Figure 1). Most personality-situation associations, however, were independent of age. These findings highlight that people's personality shapes the way in which individuals actively shape their own development through selecting everyday contexts. They also show that most of these personality-situation transactions may be largely similar across the lifespan, but that there are notable differences as well,

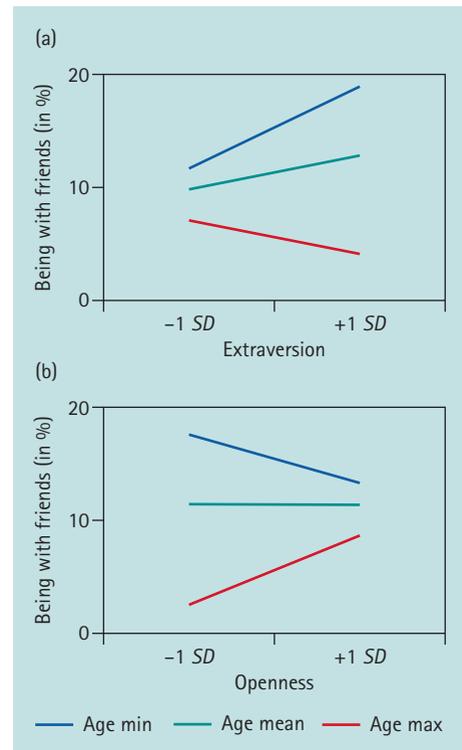


Figure 1. Personality and situation selection in everyday life. Associations between extraversion and time spent with friends were only observed in adolescents and young adults, whereas associations between openness for new experiences and time spent with friends were only observed in older adults (adapted from Wrzus et al., 2016).

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which may be related to age-grade differences in the sociostructural constraints and affordances of everyday situations (Wrzus, Wagner, & Riediger, 2016).

### **Tune Yourself In: Valence and Arousal Preferences in Music-Listening Choices From Adolescence to Old Age**

Previous findings from the MMAA project showed pronounced age differences in the affective states that people seek in their everyday lives. For example, although most people prefer positive over negative feelings most of the time and regardless of their age, adolescents are more likely than individuals from other age groups to occasionally also report contra-hedonic motivation (e.g., of wanting to maintain or enhance negative feelings; Riediger, Wrzus, & Wagner, 2014).

These findings have been replicated in various studies, which raised the question whether age-related differences in affect-regulation motivation are also reflected in people's regulatory behavior and their effectiveness. To address this question, we conducted a series of three studies using music preferences as a means to study behavioral manifestations of affect-regulatory preferences. In Study 1, we developed an age-fair music-browsing paradigm. Individuals ranging in age from adolescence to old adulthood rated the valence and arousal levels of a large number of music pieces (i.e., how bright vs. dark and how calm vs. lively they perceived the music to be, respectively). From music pieces with age-invariant rating patterns, prototypical exemplars matching into four valence-arousal quadrants (positive-high arousal, positive-low arousal, negative-high arousal, and negative-low arousal) were selected. Age differences in musical taste and familiarity were accommodated through varying the musical styles and dates of origin within this music selection. In Studies 2 and 3, we used this age-fair music selection to examine age differences in behavioral manifestations of affect-regulatory preferences, as indicated by music-listening choices. We also investigated the effectiveness of music listening

as an affect-regulatory strategy. To establish affectively relevant situations, we manipulated participants' momentary affective states (Study 2) and the salience of momentary interpersonal goals in an ostensibly upcoming discussion of a difference in opinion with a stranger (Study 3). The investigated samples included adolescents, young, middle-aged, and older adults.

In line with our hypotheses, we found age-related differences in preferences for music pieces varying in valence and arousal. In both studies, the older the participants were, the more they preferred positively valenced and low-arousing music (see Figure 2). Although the manipulations of affective states (Study 2) and interpersonal goals (Study 3) were successful, we found no effects of these experimental manipulations on music-listening choices. These findings extend previous research on age-related differences in affect-regulation motivation by implementing music selection as an everyday behavioral indicator of affect-regulatory preferences. Results of Studies 2 and 3 further show that listening to music, but not listening to affectively neutral sounds, yielded significant changes in participants' affective experiences. This suggests that music listening is indeed an effective means of affect regulation.

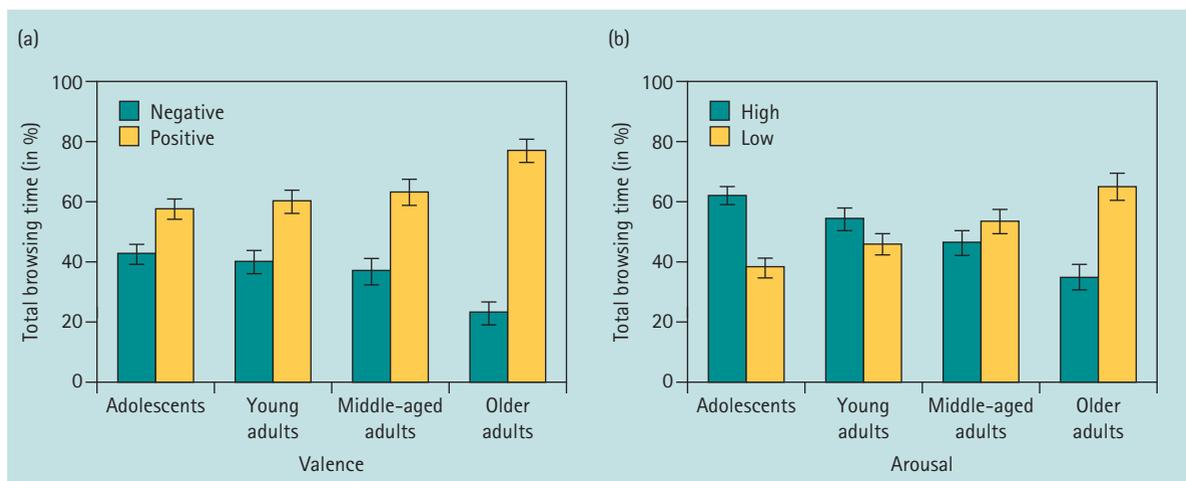


Figure 2. Age differences in music preferences (exemplarily illustrated with the example of data from Study 2). An age-fair music-browsing paradigm was developed to investigate age differences in music preferences. Participants freely browsed a preselected music collection for 10 minutes. Consistent with previous evidence on age differences in self-reported affect-regulatory preferences, we found an age-related increase in preferences for positively valenced and for low-arousing music.

## Key Reference

Klipker, K., Wrzus, C., Rauters, A., & Riediger, M. (2017). Hedonic orientation moderates the association between cognitive control and affect reactivity to daily hassles in adolescent boys. *Emotion, 17*, 497–508. doi:10.1037/emo0000241

### Adolescents' Reactivity to Daily Hassles: The Role of Hedonic Motivation and Cognitive Development

Compared to late childhood and adulthood, adolescence is a developmental period of enhanced affective instability and stronger affective reactivity to daily hassles. The reasons for this phenomenon are still under debate. Kathrin Klipker's dissertation project investigated the respective role of the interplay of cognitive, motivational, and hormonal factors in a longitudinal study with 148 adolescent boys (age 10 to 20 years).

One line of research within this project focused on the question why adolescents typically experience higher affective reactivity than children although they have comparatively more cognitive control—cognitive capacities that have been related to affect regulation and lower reactivity to daily hassles. Building on our earlier research, we assumed that motivational factors contribute to this apparent inconsistency. We expected that higher cognitive control in adolescents would only be associated with lower hassle reactivity if an individual is indeed motivated to increase or maintain positive affect. We measured cognitive control using a battery of working-memory tasks. Participants also took part in a mobile-phone-based experience-sampling phase across 2 weeks. At each measurement occasion ( $M = 46$  reports) participants reported whether they had experienced any recent daily hassles. Additionally, they rated their momentary affective experiences and their current prohedonic motivation. Reactivity to daily hassles was measured as participants' negative affect following daily hassles, relative to their personal average negative affect.

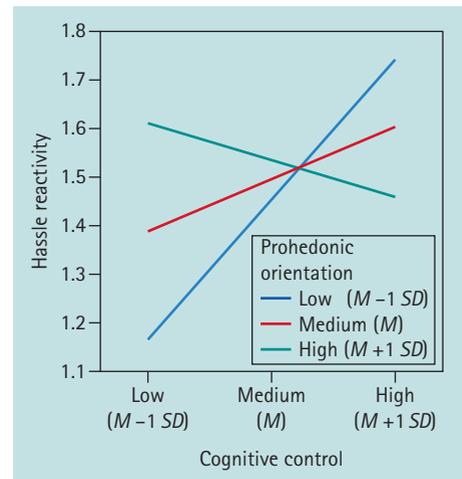


Figure 3. Associations between cognitive control and affective hassle reactivity in adolescent boys depend on their hedonic motivation. Participants' cognitive control was measured with a battery of working-memory tasks. Using mobile phones as assessment instruments, adolescents repeatedly reported whether they had experienced any recent daily hassles and rated their momentary affective experiences as well as their current hedonic motivation in daily life. Higher cognitive control was associated with lower hassle reactivity in adolescents with higher hedonic motivation. For individuals with low-hedonic motivation, higher cognitive control was related to stronger hassle reactivity (adapted from Klipker, Wrzus, Rauters, & Riediger, 2017).

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In line with our predictions, higher cognitive control was not always associated with lower hassle reactivity. Instead, in individuals with low-hedonic motivation, higher cognitive control was related to stronger hassle reactivity (see Figure 3). These findings illustrate the value of taking into account the interplay of multiple domains, like motivational and cognitive factors, for understanding adolescent affectivity (Klipker, Wrzus, Rauters, & Riediger, 2017).

## Research Emphasis 2: Age-Related Differences in Affective Competencies

The second emphasis of our research was on age-related differences in abilities related to understanding and managing emotional aspects of life. In 2014, we focused much of our respective work on processes related to affect communication. One line of research addressed the role of cultural contexts for affect communication, another addressed age-related differences in, and social functions of, the ability to recognize other people's affective states.

### German and Japanese Scripts for Anger and Shame Interactions

The goals romantic partners have for their relationships may affect the emotions they commonly experience during interactions as well as how they respond to each other. Together with Michael Boiger, a guest scientist from the University of Leuven, we tested this assumption by exploring German and Japanese scripts for anger and shame interactions in romantic relationships. Because anger is beneficial for the German goal of autonomy, we expected Germans to be more acquainted with anger interactions and have more elaborate interpersonal scripts for handling them than Japanese. For shame, which is more helpful for maintaining the Japanese goal of harmony, we expected the opposite pattern. Younger and older adults from Japan and Germany ( $N = 382$ ) indicated for eight anger (or shame) situations, how frequent they are in their lives, how intensely they would respond to them with anger/shame, how their partners would react, and how angry/ashamed they would feel after the interaction. In each of the two cultures, participants perceived those interactions to be more frequent which helped them achieve relational goals (anger in Germany, shame in Japan). Further supporting our predictions, for interactions that elicited culturally beneficial emotions, the outcomes of the scripts depended more on the expected partner reactions than on the participants' initial feelings.

### Adult Age Differences in Understanding Others' Affective States

Past research has suggested that the ability to recognize other people's emotions may decline throughout adulthood. This impression derived from laboratory research showing that older adults are typically less accurate than younger adults in labeling emotional

stimuli like facial expressions. However, the stimuli used in conventional paradigms mostly involve posed and highly artificial expressions with limited ecological validity. With the aim to contribute to a more differentiated picture of age differences in the ability to understand others' feelings, we developed several new research paradigms with enhanced ecological validity.

### *No Smile Like the Other—Adult Age Differences in Reading Smiles*

One approach toward enhancing ecological validity involved smiles instead of posed, supposedly prototypic expressions of intense basic emotions (Riediger, Studtmann, Westphal, Raters, & Weber, 2014). Smiles are facial displays well suited for our purposes because they are subtle expressions of high ecological relevance that can be accompanied by different emotional experiences: People smile when they experience positive emotions, for example, when they are amused or happy. They also smile to conform to social conventions, for example, to be polite, even when not experiencing any particular emotions. People also occasionally smile while experiencing negative feelings, for example, during social conflicts when they want to appease their interaction partner.

We produced 80 video episodes of smiles that were either accompanied by positive affect, negative affect, or no emotions, as reported by the smiling targets. We then asked younger and older participants to identify the emotional experiences accompanying these smiles. In a first study, younger viewers (20–30 years of age) were more accurate than older viewers (70–80 years of age) at identifying emotional experiences accompanying smiles, reflecting a pattern observed in conventional laboratory studies. In a second study, age differences were attenuated when

### Key Reference

Riediger, M., Studtmann, M., Westphal, A., Raters, A., & Weber, H. (2014). No smile like another: Adult age differences in identifying emotions that accompany smiles. *Frontiers in Psychology*, 5:480. doi:10.3389/fpsyg.2014.00480

the smiling target was an older adult. While enhancing ecological validity, the smiles paradigm still employed isolated cues without context. Our further attempts toward enhancing ecological validity therefore pertained to investigating affective competencies in authentic interactions. This additionally allowed for investigating social implications of age differences in empathic accuracy.

*Nice to Meet You—Social Implications of Empathic Accuracy Among Strangers*

Empathic accuracy is assumed to facilitate social interactions and promote social adjustment. However, evidence on this notion is limited, particularly for older adults. To fill in this void, Elisabeth S. Blanke's dissertation project focused on the role of empathic accuracy between strangers for younger and older adults' social adjustment. We invited 208 younger (20–31 years of age) and older women (69–80 years of age) to our laboratory, paired them in unfamiliar dyads of varying age compositions, and videotaped the dyads as they engaged in a prestructured conversation about positive and negative events in their lives. Both partners then reported how satisfied they were with the conversation and with their social relationships in real life. After the conversation, participants watched the video and reported their own positive and negative thoughts and feelings at eight time points during the conversation and judged the partner's thoughts and feelings at the same time points. Empathic accuracy was determined by the agreement between the judgment and the self-report of the other partner.

Older women were less accurate than younger women in judging their interaction partners' negative thoughts or negative feelings, but there were no age differences in empathic accuracy for positive thoughts or positive feelings (see Figure 4). These differential age effects may point to the role of motivational factors for age differences in empathic accuracy.

In addition, both for younger and older adults, associations of empathic accuracy with social adjustment depended on the valence of the internal states. The more accurately participants inferred the positive thoughts and feelings of their interaction partner, the more they liked the conversation. Importantly, there were no such associations regarding the ability to infer negative thoughts and feelings (see Figure 4). Additionally, participants' accuracy for positive thoughts—but not for negative thoughts—was related to their satisfaction with their social relationships in daily life.

Taken together, age differences in empathic accuracy were confined to the inference of negative internal states, but this ability was unrelated to social satisfaction. In contrast, there were no age differences in empathic accuracy for positive internal states, but this ability was related to participants' social satisfaction in the laboratory and in real life. These findings might indicate that age differences in empathic accuracy for strangers pertain to skill facets that have only limited implications for social satisfaction.

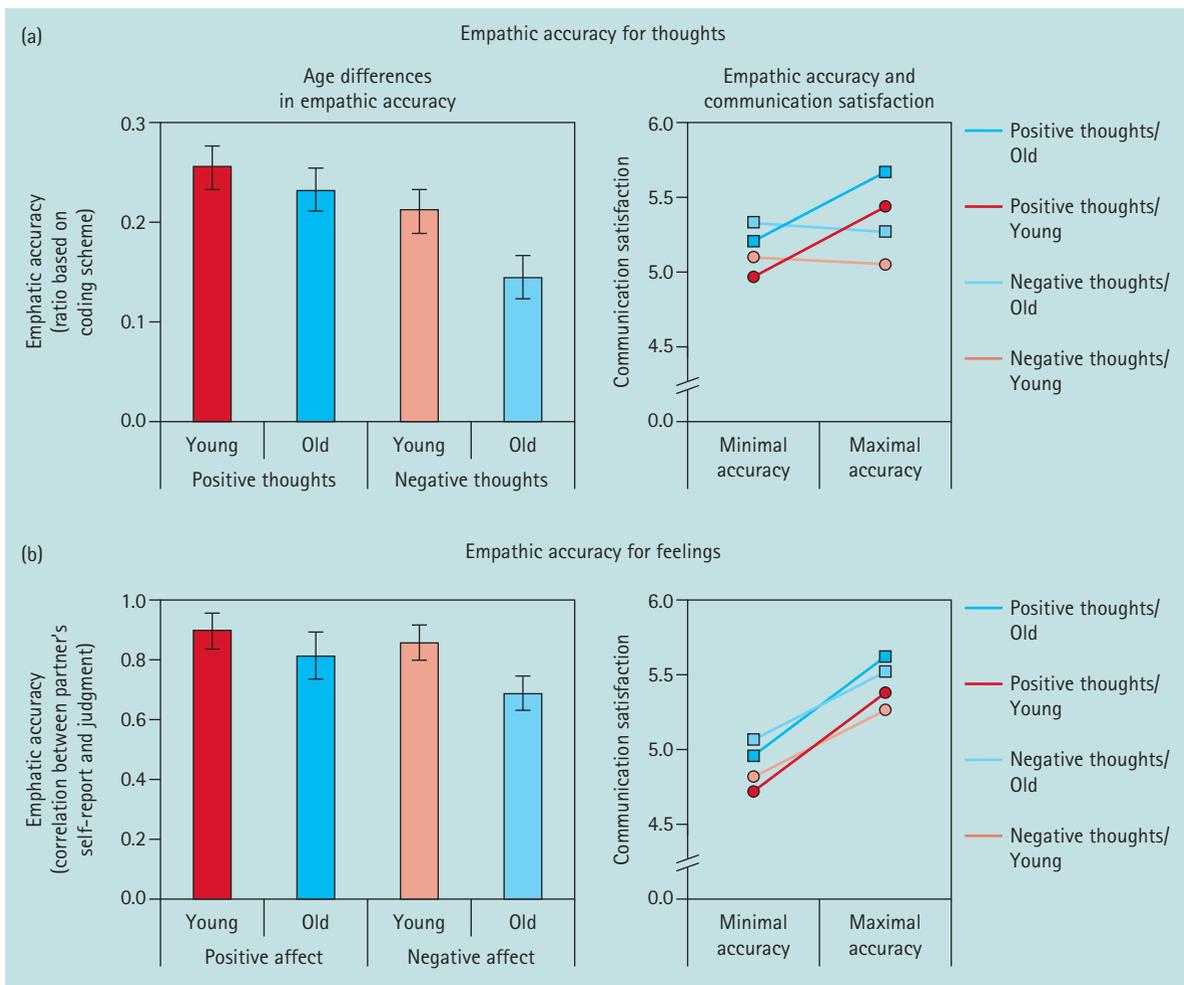


Figure 4. Age differences in empathic accuracy were only observed for negative (but not positive) internal states (left panels). Only empathic accuracy for positive (but not negative) internal states was related to social satisfaction (right panels; shown here: satisfaction with the conversation). Bars in the left panels show empathic accuracy (the ability to judge other people's internal states) separately for younger and older judges, and separately for positive and negative internal thoughts and feelings. The upper left panel represents empathic accuracy for thoughts, the lower left panel for feelings. Only for negative, but not for positive, thoughts and feelings were younger women more accurate than older women in judging their interaction partners' internal states. Participants additionally rated their satisfaction with the conversation in the laboratory and their satisfaction with their social relationships in daily life. The right panels show associations of empathic accuracy for thoughts (upper right panel) and feelings (lower right panel) with participants' satisfaction with the conversation. Empathic accuracy for positive (but not negative) thoughts and feelings was related to communication satisfaction.

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## Publications 2014–2016

(last update: Spring 2017)

- Blanke, E. S., Rauers, A., & Riediger, M.** (2016a). Does being empathic pay off? Associations between performance-based measures of empathy and social adjustment in younger and older women. *Emotion, 16*, 671–683. doi:10.1037/emo0000166
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# Max Planck Research Group

Felt Communities? Emotions in  
European Music Performances  
(Concluding Report)

Head: *Sven Oliver Müller*



#### Research Team 2014–2015

Marie Louise Herzfeld-Schild (as of 10/2015: University of Cologne, Germany), **Sven Oliver Müller** (as of 10/2015: University of Tübingen, Germany), Sarah Zalfen (as of 08/2014: Ministry of Science, Research and Culture, Brandenburg, Germany)

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## Overview

The social relations brought into existence by musical performances can be regarded as results of emotional experiences. Publicly accessible emotions trigger people to communicate more easily. Does music create “felt communities”—and if so, how? That is the basic question of the Max Planck Research Group “Felt Communities? Emotions in European Music Performances.” It analyzed the historical development of emotions in musical life in Europe in the 19th and 20th centuries. The group consisted of ten historians, musicologists, political scientists, and ethnologists. Learning from and with each other facilitated access to a multitude of different theoretical concepts and disciplines. Our various outcomes showed a remarkable congruency despite our diverse academic backgrounds; our research methods made a common basis for comparison possible. The Research Group began its work in 2010 and ended in summer 2015. This research report contains the main results of our research as well as sketches of the individual projects of the final year’s active researchers, namely, Sven Oliver Müller, Marie Louise Herzfeld-Schild, Lena van der Hoven, and Luis-Manuel Garcia, all of whom are meanwhile continuing their research elsewhere.

Our aim was to find out what role music plays as a performative practice for the cohesion of social groups in various historical contexts. No distinction was made between “serious” and “popular,” between “classical” and “modern” music. The field of relevant problems and approaches ranged from sociologically inspired analyses of 19th-century church music, historical research on audiences, to studies of techno music.

*Music, Emotions, and Communities:* These are the main categories we worked with. Focusing on emotions as a public form of communication, the aim was to decipher the emotional structure of communities: What role did and does music as an emotional mode play in the development and cohesion of communities? The concept is a history of social and cultural relations in musical life. Instead of defining boundaries between the three investigated categories, we examined the relationships and interactions between music, emotions, and communities. It is a model of communication: Neither the musician, nor the composer, neither the ruler, nor the audience were examined separately. Their relationship could be defined as a chain of communication. Emotional communities are not communities of their own—but, almost by definition, an important aspect of many social groups in which people have common interests and habits. It was the task of the researchers in the group to uncover systems of feeling and to establish what the examined communities define as the

emotions that they value, devalue, or ignore. At the end of this process of negotiation and consumption, you can frequently find emotional icons in musical life everywhere.

Our research projects complement and extend the findings of psychological and neurobiological studies, according to which individual sounds, chords, and melodies can cause detectable vegetative, cognitive, and emotional reactions. Our historical and aesthetic reception perspective is based on the assumption that music in its entire complexity can only be fully understood when taking into account its emotional impact as well as its specific context. This context consists of performance spaces and artifacts, ranging from concert halls to MP3 players, of physicality such as movement and performance by virtuoso musicians as well as dancers at techno clubs, of learned musical and extra-musical familiarities and individual tastes, and finally and foremost, it consists of the joint hearing experience. Naturally, laboratory conditions cannot offer such complex textures. Therefore, we need to interpret and reconstruct them from a variety of sources including audio and video documents, music reviews and fan magazines, diaries and letters, memorabilia and merchandising products. It is also necessary to investigate the reception of music for the formation of social groups. We know much more about scores, genres, aesthetic shifts, and the music of great male composers than we know about the impact of music upon the formation of the social sphere.

We suggest a change of perspective, moving away from the study of musical works to an investigation of interpretive processes. The assumption is that the meaning of music is, to a large part, the result of interpretational processes in the public sphere. The same piece of music may evoke different public reactions in relation to different emotions of the performances. Emotions vary over time and place and they are historically, culturally, and socially contingent. Indeed, emotional experiences themselves may be subject to change. Some feelings strike particular resonance with us today—for instance, shame and compassion—which people around 1900 hardly acknowledged.

The main goal of our research group was to investigate emotional practices and procedures as well as their effects on societies since the 1780s. Hence, one analytical focus was placed on the historical process of musical performances and their political and social interpretation. Our projects could shed more light on the social and emotional meaning of music for communities both of the past and the present. We concentrated on those communities' effects rather than on the analysis of singular musical works or musical genres. Political and aesthetical discourses, social

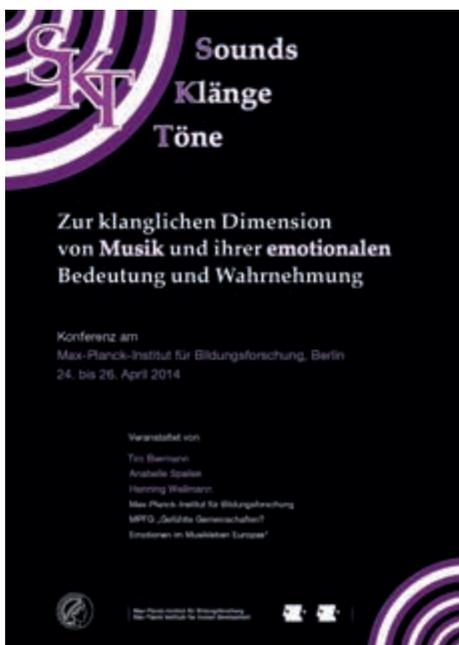
practices, and the processes of community formation were thus explored via this innovative change of perspective. This context stimulated a different way of researching society and the reception of music. This was due not only to competing emotional interpretations but also to the absence of certain communities from emotional exchange. We could often find consistent communication and strategies of refusal right next to each

other; the interaction of these two behavioral patterns formed the foundation of solidarity and fragmentation of communities in musical life. Hence, we established five categories in order to grasp societal context and possibilities of action of groups over time, places, and musical genres: practices, spaces, styles, discourses, and functions. This not only facilitates the analysis of each category but also the comparability of our individual projects and topics.

### Conferences

The group's conferences demonstrate how its research is the result of fruitful scientific exchange with many colleagues inside and outside the Institute. The weekly research group meeting was an important medium for academic communication. The variety of conferences, workshops, and cooperation projects reveals the outcome of these research activities among the disciplines of history, musicology, political sciences, and ethnology. The group's doctoral students (Tim Biermann, Anabelle Spallek, and Henning Wellmann) organized the conference, *Sounds Klänge Töne: Zur klanglichen Dimension von Musik und ihrer emotionalen Bedeutung und Wahrnehmung*, from 24 to 26 April 2014. It was concerned with musical sound worlds and their emotional effect in time-bounded social and cultural contexts. How and by whom is music attributed to emotions? What meanings do sounds receive through the attribution of emotions and vice versa? What emotional patterns of perception can be distinguished in specific historical sound contexts and settings? These are examples of questions that were discussed.

The final workshop of our research group, *Emotionsgeschichte und Musik: Forschungsperspektiven und Methoden*, took place on 18 and 19 September 2015 in Berlin. This workshop aimed to discuss and assess essential methodologies of our works as well as at inviting new perspectives on the relationship of music and the history of emotion. The workshop served as an interdisciplinary platform to present innovative ideas to research music and emotion, on the one hand, and to discuss future perspectives and different



approaches to, and applications of the term “emotion,” on the other hand. The workshop’s speakers hence sketched further and new approaches to the emotional meaning of music for existing and forming communities. The speakers not only extended the time frame to the period before 1700, they also expanded our understanding of what music could be. The workshop aimed at bringing scientists from a multitude of fields around one table. This interdisciplinary approach promised novel input and original perspectives from the integration of various methods and the common effort of different disciplines. Subsequently, we came closer to the comprehension of emotional discourse, and we discussed definitions of emotional practices and emotional spaces of musical practice. Participants presented topics ranging across fields such as music reception, music history, social history, music aesthetics, and musical analysis. The list of workshop participants comprised leading representatives from different disciplines as well as up-and-coming young scientists and master students. The spectrum of topics combined opera of the modern age, hi-fi culture of the 1950s, dance culture, and the history of the British stock exchange. Also, Susanne Rode-

Breymann (Hanover University of Music, Drama and Media) agreed to collaborate in the publication of a volume representing this workshop. Our research group illustrated its methodologies by presenting different case studies and approaches. These focus on musical places and topics that are so important that they allow for historical generalization. The emphasis is on comparable cultural performances at different social places in different political contexts. The point is to ask whether different musical performances in different places account for similar emotional effects on audiences. The differences in musical life are obvious—but the emotional similarities are nevertheless clear.



### The Infinite Varieties of Feelings—Conductors as Producers of Musical Meaning

Conductors are a mysterious breed. Oozing self-belief, elevated on a podium, they are endowed by critics and public alike with magical abilities. There is no more obvious expression of power than the performance of a conductor. Yet, for all this power, what they actually do remains an enigma. In fact, it is one of the most frequently asked questions of an orchestral musician. But how much difference does the average conductor make? Even in the case of the talented few maestri, the skills on offer are subject to an indefinable alchemy of charisma and self-belief. And as is the case with any dictator, what seems paramount is the ability to inspire confidence in their powers. Conductors have to advise the members of an orchestra by testing the musicians’ technical abilities, on the one hand, and by demonstrating the cultural meaning of a composition for a wider public, on the other. Therefore, conductors are interested in emotions as a

cultural practice. This project has a focus on the conveyance of music via emotions incorporated in the conductors’ work. The aim is to find out how conductors are familiar with employing feelings in order to share their visions with the musicians through emotional imagery, gestures, and anecdotes. We believe that conductors especially make emotions visible and tangible through music. But what exactly are emotions from the perspective of a conductor, and where do they become vital? For instance, we ask how conductors translate music into emotional language during rehearsal. It is interesting to discover the metaphors, gestures, and jokes through which they manage to captivate not only the musicians but also their audience. Our aim is to compare highly controlled forms of behaviors with highly expressive facial gestures and body movements. It will be interesting for the impact of emotions in musical

### Researcher

*Sven Oliver Müller*

life to analyze how conductors try to model feelings during a rehearsal to produce, for instance, an “ugly” sound in a certain passage in which they believe it suits the expressive meaning of the music. We hope to find out how emotionally charged pieces of art acquire meaning among musicians, entrepreneurs, and audiences. We have just finished this series of interviews with Nikolaus Harnoncourt, Christian Thielemann, Marek Janowski, Simone Young, and Kristiina Poska. It is our goal to use some of these interviews as source material for a publication and to try to reach a broader audience in public discussions.

## Researcher

Marie Louise  
Herzfeld-Schild

### Between Sense and Sensibility: Emotional Aspects of Religious Chants in the 19th Century

The age-long discussions between the church authorities on the right way of plainchant singing have always been concerned with the question of how much emotionality religion can tolerate. Because music, as a “language of emotions,” seems to touch people more directly than words, its appropriate form and content have always been of greatest importance. Therefore, church music, allowed during various periods of time, can be understood as a mirror for the theoretical emotional do's and don'ts of each period, while the preferences and wishes of the faithful with their particular musical-emotional religiosity often form a practical counter pole to it.

The project focuses on the emotional dimensions of church singing in the 19th century, considering both theory and practice. The main thesis is that, on the basis of the then theoretical discussions about the “true” way of plainchant singing as well as their practical implications, a new sacralization and thereby re-emotionalization of religiosity—a “religious feeling”—can be traced that emerged in the course of the late 18th and 19th centuries in both Christian denominations of the German-speaking world as a backlash to the rationalism of Enlightenment theology.

The project proposes that this increase in religiosity and the role of emotion in it can be detected in the song books, religious song collections, theological treatises, and hymnological writings of the 19th century. These sources reveal contemporary aspects of lived religiosity, devotion, and musical-religious everyday



Figure 1. Conductor.

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life that, on the one hand, shed light on the significance of music in and for the church and, on the other, contribute to the history of emotions of the 19th century. Church songs and song books as cultural documents allow for a broad cultural and historical investigation with a social and emotional focus. Considering the assumption that emotions are culturally acquired and can accordingly be shaped and changed, interpretations of individual cultures of emotion can be made on the basis of the cultural practices of the past.

By analyzing the emotional vocabulary, the emotional topology of religion and music, and the role of religious singing for establishing “felt communities,” the project attempts to answer (1) how singing in church cultivated emotions; (2) whether an emotional “surplus” or extra emotional weight was assigned to music in religious practices in contrast to mere spoken words; and (3) how “religious feeling” in the 19th century and its ideological basis can come to be defined by means of the historical texts on religious singing.

The project takes its departure at the huge implications that the Enlightenment had on singing in Christian churches. Within Enlightenment theology, rational thought became more and more important for religion, while the sensory perception of religion was highly regulated. Accordingly, in both Christian denominations, church music was made to conform to this primacy of rationality, and visual and acoustic embellishments were even to some extent removed from churches. Reli-

gious revelation was combined with rational comprehension in contrast to prior notions of intuitively feeling and sensing the divine. Through the influence of Josephinism in Austria in the 1770s and 1780s and later also in Germany, religious services were changed, feast days cancelled, processions shortened, and communal rosary prayer banned. Large-scale masses were no longer performed and, instead, church members became actively involved in shaping the musical aspects of services. Masses in German were introduced in Catholic churches, and the genre of the "German sung mass" has its origins in this period, which is known as the "Late Catholic Enlightenment" and lasted until around the mid-19th century.

At that point, however, a strong restoration movement gathered pace, which even attempted the reintroduction of Latin Gregorian chant for reasons of feeling and sensing the divine rather than thinking about it. Therefore, singing was reintroduced into service for just this purpose of deepening the role of emotion in religion and religiosity.

### **Perspectives of a History of Emotion of the 19th-Century Opera**

The project on the formation of emotional communities in the 19th-century opera started in December 2013. It investigates the representation, creation, and reflection of "religious feeling" in German opera houses and its effect on the formation of emotional communities on stage as well as in the audience. The interdisciplinary approach incorporates methods from the fields of emotion theory, music sociology, history, and theater studies. One central term is that of "Innerlichkeit," which raises the question of whether this "Innerlichkeit" existed at all and in what way it was and is presented in the opera house. As Roger Parker said, 19th-century opera should not only be considered a place of reflection on societal and cultural topics, it should rather be considered as the place of creation of said topics; and, in doing so, opera gives those topics language and space to become a private emotion and infuse the "real" world. The 19th century manifested a growing need for religious music as well as for theatrical representations of religious topics outside of

In their prefaces, their structure, their content, and their distribution, the hymnals of the late 18th and 19th centuries show how the huge changes in lived religiosity—from the purism of Enlightenment theology to the singing of emotionally charged hymns within the restoration—were practically realized within the religious communities. Especially comparisons between consecutive song books, their song selection, the selection process and justification tell us a lot about the changing role of emotion in the religiosity of that time.

The following questions emerge: Which social, political, or theological motivations form the basis for the emotional and musical concepts and practices in religiosity? Can devotional differences be found in the musical-religious emotionality of that time? And finally: Is it possible to construe information about the understanding of music as a "language of emotions" in the late 18th and 19th centuries from the interplay of the theological-theoretical discussions and the musical-religious practices found in the sources?

churches. This phenomenon also showed on the operatic stage in form of an increasing negotiation of religiosity and religion as an aesthetic and emotional paradigm. While the performance of a religious scene on the operatic stage was a taboo before 1800, the 1820s not only propagated such presentation, it also criticized the church via performances. Religions and confessions already present emotional communities. Praying is a fundamental act of religious practice as well as an essential contribution to the formation and preservation of communities of faith. Opera can be compared to praying in that it is a moment of the human way of interpreting the self and the world.

The research project can be divided into two parts: The first part concerns religious scenes and prayers on the operatic stage, and it contextualizes this performed religiosity with musical and textual structures. The focus is on musical, corporal, and gestural presentations of religiosity; thereby, special attention is paid to the depictions of communal, choral

### **Researcher**

*Lena van der Hoven*

praying, on the one side, and of individual, personal prayer, on the other side. The second part of my research project takes a closer look at the formation of communities amongst the members of the audience. It will be especially interesting to see whether choral and individual prayers evoke different reactions

and whether one depiction of praying is more likely to create an emotional community. One could assume that the dynamics of the choral scenes have a more rousing effect on the audience, whereas personal prayers offer a higher potential for identification.

## Researcher

*Luis-Manuel Garcia*

### **"Can You Feel It, Too?": Music, Affect, and Intimacy in Contemporary Urban Electronic Dance Music Scenes**

This ethnographic project focuses on social behavior on the dance floors of electronic dance music (EDM) events, where crowds of strangers come together and get on in un-strangerly ways, participating in euphoric performances of utopian togetherness that emerge through gestures of social warmth, moments of candor, and the sharing of intense musical experiences. On the dance floors of nightclubs, loft parties, and raves, partygoers engage in forms of stranger-intimacy that short-circuit conventional narratives of intimacy and transgress normal, "daylight" decorum. But how does such intense stranger-intimacy arise and endure? In what registers is it felt and articulated? The project addresses these questions through an intertwining of ethnographic research in the electronic dance music scenes of Paris, Chicago, and Berlin; the analysis of these scenes' musical aesthetics; and an engagement with current scholarship on themes of affect, touch, and intimacy. This multi-sited project is based on ethnographic fieldwork conducted across three cities and between the years of 2006 and 2010. The project aims to impact the fields of music and dance studies, anthropology, popular culture/cultural studies, sexuality studies, and critical geography—particularly those subfields that take interest in music scenes and live events. Most partygoers seem to want fluid and capacious forms of belonging that are loosely held together by musical affinities and by the dance floor's affective intensities, but they must contend with the contradictions inherent in embedding such imagined worlds in one that is already striated with exclusions. They want distinction without discrimination—belonging beyond the categorical exclusions of identity—and they sustain the

fragile sense of such a utopian world through a sort of socially-operative vagueness, routed through aesthetics and affect rather than identity. But these fluid practices of vague belonging are not entirely buoyant: Beneath these utopian fantasies of open belonging, the testimony of participants as well as fieldwork observations reveal fissures, inequities, and exclusions that often go unexamined. This project is dedicated to exploring how such scenes can support transient-but-real world-making projects by striking an ambivalent bargain with vagueness, which both enables these worlds to "feel" imminently possible and provides cover for their underlying contradictions. By focusing on contemporary dance events, this project also brings spatiality and corporeal co-presence to the fore, reconceptualizing stranger-intimacy through relays between space, affect, and music. It engages with current research in urban studies and critical geography that theorize the connections between stranger-sociability, affect, and built environment.

This project has already produced two essay-length publications, with a monograph-length publication remaining the final goal. The first output from this project was a chapter in an edited volume, which provided an ethnographic account of the loose forms of sociability at electronic music events. It developed "liquidarity" as a concept to describe how this stranger-intimacy works in contexts of anonymity and face-to-face contact. The second major publication was a peer-reviewed article in the inaugural issue of *Sound Studies*, a journal dedicated to this emergent and dynamic field of research; this article provides an analysis of "sonic texture" in several recordings of electronic dance music, highlighting how texture and tactil-

ity provide an experiential relay between vibratory sensation and affect—thus providing a theoretical model for conceptualizing the transmission of affect via sound. Finally, the planned monograph (provisional title: *Together, Somehow: Music, Affect, and Intimacy on the Dancefloor*) is now in the final phase of drafting. In order to expand the public impact of the research project and of this research group, Luis-Manuel Garcia wrote several feature articles for the leading magazine for electronic dance music, *Resident Advisor*; and performed an hour-long interview podcast for *Resident Advisor* to discuss his current research in great detail.

This project intertwines with a second, newer research project that is currently in the data-collection/fieldwork stage. This second postdoctoral research project, entitled *The Techno Jetset: Mobility, Tourism, and the Creative Class in Berlin's Electronic Dance Music Scenes*, examines the recent emergence of "techno tourism" in Berlin as both a cultural and commercial phenomenon as well as its entanglement with various forms of spatial and social mobility. The initial phase of fieldwork already revealed that many "techno tourists" also make the decision to move to

Berlin for longer stays, thus expanding this project's scope to consider not only tourism but also migration, which in turn raises issues concerning the economic and working conditions of "creative class" industries as well as the impact of gentrification on urban music scenes. Of particular relevance to this research group's theme is the role that feelings and emotions play in grounding both tourists' and migrants' sense of belonging to their adopted city; in particular, music plays a central role in creating affective points of connection between those invested in these musical genres, which helps them to sustain a sense of musical community as well as of belonging to a local, spatially-grounded music scene. As a secondary project to the book manuscript, this research has already led to two articles: one examining the affective dimensions of civic and musical belonging for "techno migrants" living in Berlin and the other providing an ethnographic sketch of "techno tourists" and their neoromantic relation to Berlin as a postindustrial city. A further article is planned that traces the implication of local EDM scenes in current debates about tourism and gentrification in Berlin.

### The Research Group's Results

A preliminary result of our research from the years 2014 and 2015 is that it seems promising to examine isolated performances and identify broader historical processes on the way. It can be useful to compile a bigger picture out of little mosaic pieces. We would like to conclude with three considerations:

(1) Music gains its emotional agency from the practices, performances, and discourses in the musical life of a particular time. The emotional agency of music is a perfect vehicle for consumers to place themselves in an "imagined community." Music's potential as a medium of "imagining communities" is twofold, however. It can both induce submersion into the mainstream or can construct spaces of difference. The emotional reception of music might not always generate a community, but can shape it.

- (2) Music is more than music. It is formed not only by scores, pieces, and sounds, but by its complete contexts, including performance spaces, artefacts, and bodies, as well as the behavior of audiences and learned musical or extra-musical tendencies. Therefore, the actions of musicians and audiences should be an important object of future analysis.
- (3) It seems hard to detect similarities in the history of emotions in musical life. However, it can be observed that music, emotions, and communities develop and interact within comparable paradigms. Listeners have the potential to hear different things in the same music, but the fact that many of them do not is an indication of the degree to which groups experience common perceptual adaptation. Researchers will continue to investigate the development of emotional settings.

## Publications 2014–2016

(last update: Spring 2017)

**Garcia, L.-M.** (in press). Whose refuge, this house? The estrangement of queers of color in electronic dance music. In F. Maus & S. Whiteley (Eds.), *The Oxford handbook of queer-ness and music*. Oxford: Oxford University Press.

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# Heisenberg Research Group

Socioemotional Development and  
Health Across the Lifespan

Head: *Michaela Riediger*



#### Research Team 2014–2016

Sandra Düzel (MPI for Human Development, Berlin, Germany),

**Michaela Riediger** (MPI for Human Development and Freie Universität Berlin, Germany; as of 03/2017: Friedrich Schiller University Jena, Germany),

Antje Rauers (09/2015–02/2017: Freie Universität Berlin, Germany; as of 03/2017: Friedrich Schiller University Jena, Germany)

## Overview

The Heisenberg Research Group “Socioemotional Development and Health Across the Lifespan” seeks to contribute a more differentiated understanding of the interplay of socioemotional and health development across the lifespan. To meet this aim, we conduct interdisciplinary research projects with national and international cooperation partners. Current research projects investigate associations between emotional experiences and competencies with health, spanning an age range from childhood to very old age. We use multiple methods, among them mobile phones, to assess experiences—such as events, behaviors, feelings, or thoughts—at the moment of their occurrence and within the context of a person’s everyday life. This method is combined with the monitoring of physiological parameters, such as physical activity, cardiac functioning, or hormonal processes, and laboratory-controlled experimental paradigms and behavioral observations. The research group is part of a cooperation of the Freie Universität Berlin and the MPI for Human Development and is partly funded by the Focus Area DynAge and a Heisenberg stipend awarded to Michaela Riediger by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), RI 1797/3-1. At the Freie Universität Berlin, the group is associated with the Division of Health Psychology. It started its work in September 2015. Below, we describe three ongoing research projects of our group.

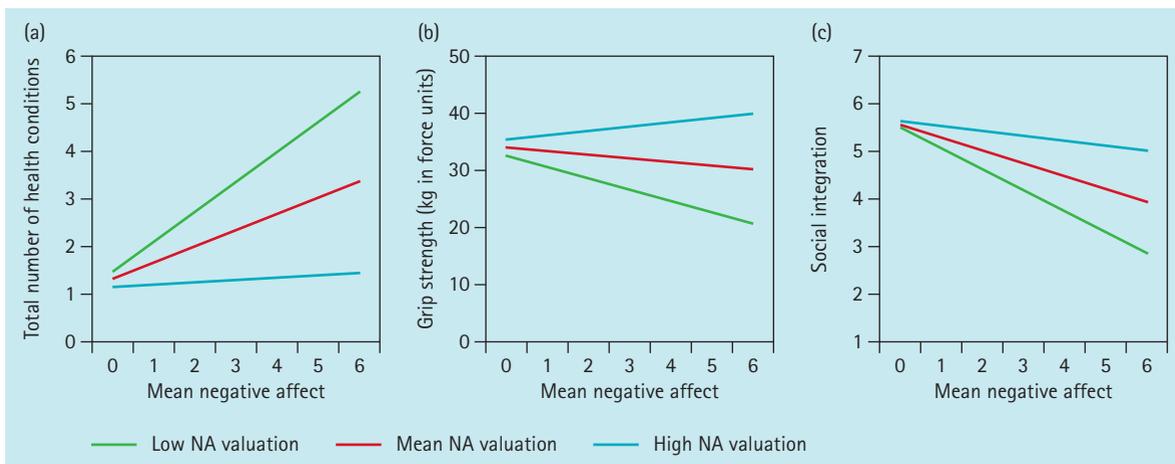
### **When Bad Moods May Not Be So Bad: Valuing Negative Affect is Associated With Weakened Affect-Health Links**

Previous research has suggested that people with high levels of negative affect, both in terms of intensity and frequency, tend to experience poorer physical health and lower levels of psychosocial functioning (e.g., less social integration). Much of this work, however, has overlooked how appraisals and valuations of those affective experiences may moderate these links. Individuals may differ in the extent to which they value particular affective experiences; and individuals who are better able to see that negative emotions are not just unpleasant, but may at times be helpful, meaningful, and appropriate in certain contexts, may show dampened links between daily experiences of negative affect and poorer health and well-being. Together with our collaborator Gloria Luong (Colorado State University, Fort Collins), we investigated this hypothesis using data from the *Multi-Method Ambulatory Assessment* (MMAA) project. The MMAA project is an ongoing longitudinal research endeavor in cooperation with Max Planck Fellow Gert G. Wagner and was initiated in the Max Planck Research Group “Affect Across the Lifespan,” which concluded its work in December 2014 (see pp. 231–240). The Heisenberg Research Group continues this work. In the MMAA

project, we developed a new measure called the *Positive and Negative Affect Valuation* scale. This scale assesses the frequency with which people value a variety of positive (e.g., joy, interest, contentment) and negative emotions (e.g., angry, downcast, nervous) as pleasant, helpful, appropriate, and meaningful experiences. We examined the extent to which these affect valuation measures may moderate known links between affective experiences and physical health and psychosocial well-being in a lifespan sample of 365 community participants ranging from 14–88 years of age. Affective experiences were assessed in participants’ daily lives, using mobile-phone-based experience sampling. Measures of physical health included both self-reports (e.g., number of health conditions) and objective measures (e.g., hand grip strength). Psychosocial functioning was assessed with self-reports of emotional health problems and social integration. We found that the more people valued negative affect, the weaker were the associations between their average daily experiences of negative affect and poorer health (total number of health conditions, health complaints, physical well-being, and grip strength) and psychosocial functioning (see Figure 1 for illustrations of some of these effects). Positive affect valuation, in contrast, did not moderate analogous affect-health associations in a similar manner

### **Key Reference**

Luong, G., Wrzus, C., Wagner, G. G., & Riediger, M. (2016). When bad moods may not be so bad: Valuing negative affect is associated with weakened affect-health links. *Emotion, 16*, 387–401. doi:10.1037/emo0000132



**Figure 1.** Negative affect valuation moderates the associations between experiences of negative affect and indicators of physical and psychological health and well-being [(a) total number of health conditions, (b) hand grip strength, and (c) social integration). The more individuals valued negative affect, the less pronounced (and sometimes even nonexistent) were the associations between everyday experiences of negative affect and self-reported and behavioral indicators of poorer physical and psychosocial functioning (adapted from Luong et al., 2016).

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to negative affect valuation (Luong, Wrzus, Wagner, & Riediger, 2016). This work builds on the literature because much of the work to date has focused on reducing negative affect or reevaluating how people appraise hassles as a means to promote health and well-being. Findings from this study suggest that how people evaluate and value different affective experiences, particularly negative ones, may provide new insights into understanding affect-health links.

#### Key Reference

Harden, K. P., Wrzus, C., Luong, G., Grotzinger, A., Bajbouj, M., Raters, A., Wagner, G. G., & Riediger, M. (2016). Diurnal coupling between testosterone and cortisol from adolescence to older adulthood. *Psychoneuroendocrinology*, 73, 79–90. doi:10.1016/j.psychoneu.2016.07.216

#### On the Interplay of Endocrine Functioning and Socioemotional Competencies From Adolescence to Old Age

This ongoing cooperation with various institutions inside and outside of Berlin is funded by the Focus Area *Disease in Human Aging: Dynamics at the Level of Molecules, Individuals, and Society* at the Freie Universität Berlin. Its central aim is to better understand the interplay between endocrine influences and mental health across the lifespan. We are particularly interested in the role of stress and sex hormones, which have been implicated in previous research as potential neurobiological underpinnings of mental health and disease. To date, both systems have mostly been investigated in isolation. Recent evidence, however, suggests it may be their interaction that is

particularly decisive in determining mental-health vulnerabilities. This evidence stems from younger individuals mostly. Not much is known about these interaction effects in other age groups. Furthermore, the mechanisms that link hormonal influences with mental-health outcomes are also not yet well understood. We propose that socioemotional competencies may represent one such pathway, that is, abilities related to experiencing, understanding, and managing socioemotional aspect of life.

As a first step, we addressed the most basic aspect of our working model, namely, the interrelation between the stress and sex hormone system, looking at their most prominently studied end products, namely, cortisol and testosterone, respectively. This work was conducted in collaboration with K. Paige Harden from the University of Texas at Austin (Harden et al., 2016). A widespread assumption in the literature is that the stress-reactive and reproductive systems are mutually inhibitory. Stress is assumed to impede reproductive function and vice versa. Contrary to this assumption, however, recent studies with adolescents and young adults found positive within-person associations of testosterone and cortisol, suggesting that the two hormone systems may serve complemen-

tary rather than antagonistic functions. The purpose of our analysis was to extend this research to older age groups as well in order to allow an age-comparative approach spanning the entire age span from adolescence to old age. This is important because both hormone systems undergo differential developmental change from adolescence to old age. Whereas during adolescence activities in both the reproductive and stress-response system increase after a period of childhood quiescence, sex-hormone levels decrease in middle-aged and older adults while cortisol levels increase. This raises the question whether the recently observed positive coupling may be specific to the investigated age range from adolescence to young adulthood.

To address this question, we used data from the MMAA project. The analytic sample included 292 individuals ranging in age from 11 to 88 years. Participants provided six ambulatory saliva samples in their natural life contexts on 2 consecutive days, each at waking up, 30 minutes later, and at 7:30 pm. From these samples, free testosterone and cortisol concentrations were determined. Descriptive information showed expected patterns of diurnal, age, and sex variations in the obtained hormone levels and thus demonstrated the reliability and validity of the ambulatory hormone assessments.

Regarding within-person associations between testosterone and cortisol, four findings are particularly noteworthy: First, on average, and across the entire sample, the within-person association between testosterone and cortisol was positive (which stands in contrast to the widespread assumption that the sex and stress systems are mutually inhibitory). Second, this positive association could not be fully explained by the partly parallel circadian rhythm of both hormone concentrations. It remained positive even after accounting for this diurnal trend. Thirdly, there was no evidence for age or sex differences in this association. Fourthly, even though the average association was positive, there was substantial between-person variation in all investigated age groups. In the future, it will be interesting to explore the reasons for these interindividual differences in testosterone-

cortisol coupling and their potential consequences for mental health and well-being.

### Project "People in My Life"

The *People in My Life* project is an interdisciplinary innovation project funded by the Jacobs Foundation. This collaboration between Antje Rauers (Freie Universität Berlin; developmental psychology), Johannes Schöning (University of Hasselt, Belgium; computer science), and Sevasti-Melissa Nolas (Sussex University, UK; social psychology) aims at developing and testing a novel tablet application—the *People in My Life App* for use in social-work practice with children. The application uses touch screens with tangible objects to allow children to reenact real relationship dynamics.

A central aspect of social-work education and practice is to develop the ability to identify supportive relationships. Social workers draw on a range of existing tools to learn about important relationships in a child's life. A central objective leading the current development of the new application is to foster the inclusion of children's own perspectives in this process. In contrast to established expert-led practices for assessing relationships (e.g., genograms), the new application enables children to show and tell social workers their own relationship stories. To accommodate children as users, the application relies on three-dimensional symbolic figures that were specifically designed and created for this project (see Figure 2). This playful approach was chosen to help reduce



Figure 2. *People in My Life App* for use in social-work practice with children. The project *People in My Life* develops and tests an iPad application that encourages children to tell social workers about their close relationships.

© People in My Life Project, Antje Rauers

potential inhibitions in children and invite interactions between the child and social worker as they comment on the scenario. The movements of the figurines, their identities, and the conversation accompanying the entire activity are recorded and can be used for future review and analysis. The app is being developed consulting with the central user groups of the application—social workers and children. The conceptual framework of the project and the app design were informed by social workers, and the

results of the project will be subjected to the social-workers' evaluation at the end of the project. The application was tested with children aged 6–11 years in Brighton, UK. Children's direct feedback regarding the usability of the app will be analyzed using qualitative and quantitative data analysis. In addition to information regarding usability, we assessed a battery of covariates that will allow us to explore associations between dynamics of the children's play with sociodemographic characteristics, well-being, and health.

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(last update: Spring 2017)

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# Otto Hahn Research Group on Associative Memory in Old Age

Head: *Yvonne Brehmer*



Research Team 2014–2016

**Yvonne Brehmer**

*Predoctoral Fellow*

Nina Becker

## Overview

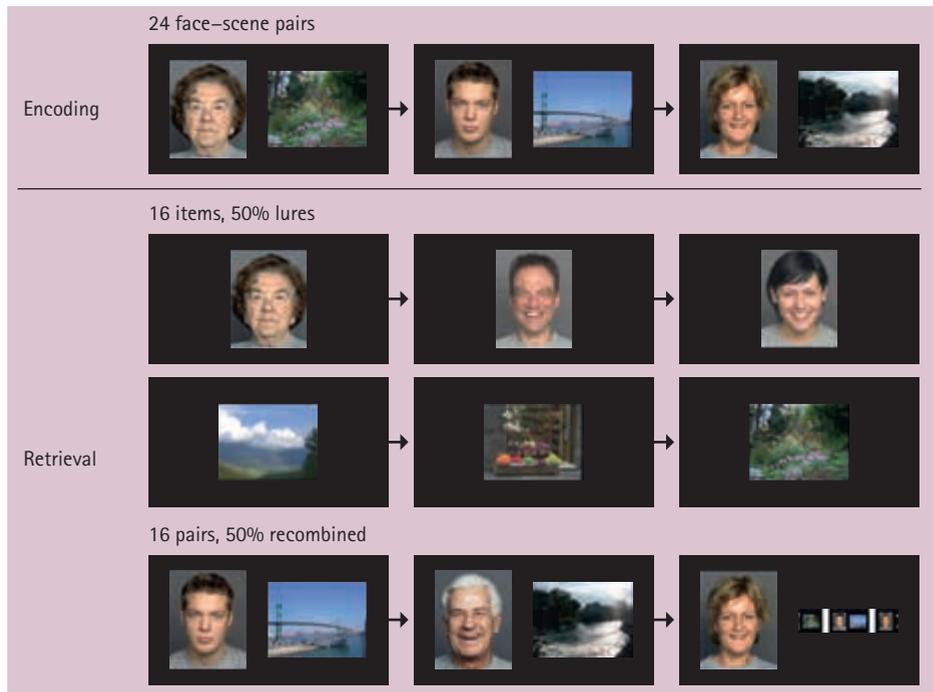
The Otto Hahn Research Group on Associative Memory in Old Age led by Yvonne Brehmer explores mechanisms contributing to individual differences in associative binding among older adults. Typical research questions are: Which cognitive, social, health, and lifestyle factors contribute to individual differences in associative binding? What are the genetic as well as functional and structural brain characteristics of older adults who show well-preserved associative binding skills?

This group was established in December 2012 and is funded by the Otto Hahn Award of the Max Planck Society, which was presented to Yvonne Brehmer for her dissertation on episodic memory plasticity across the lifespan. Nina Becker joined the group in August 2013 as a predoctoral fellow. The group's work is primarily based on data from the Swedish National Study on Aging and Care (SNAC-K), which is coordinated by the Aging Research Center (ARC) at the Karolinska Institutet in Stockholm, Sweden. Memory for associations, such as linking a name to a face, is of fundamental importance

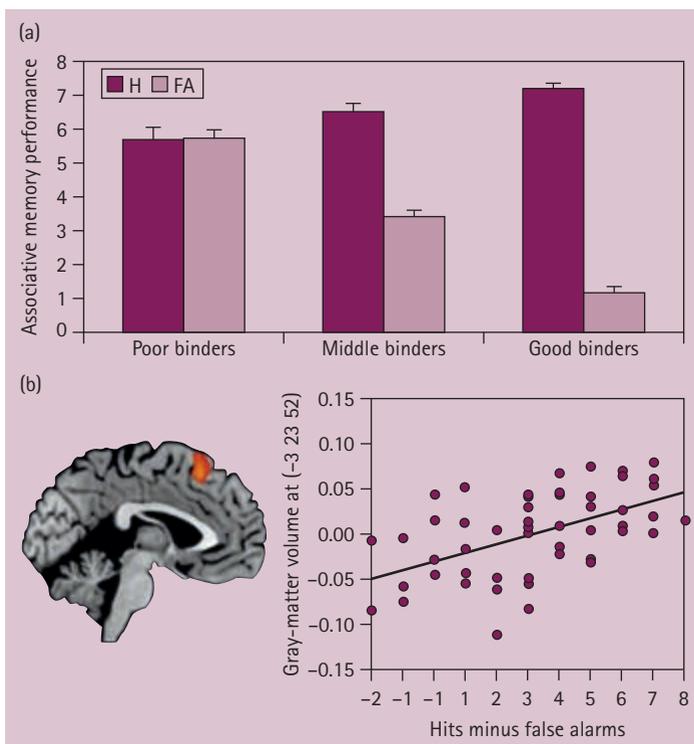
for individuals' well-being, independence, and mental health in old age. However, older adults often show disproportionate difficulties in remembering associative information. We investigate the mechanisms underlying between-person differences in associative memory in old age. The basic questions we pose are: Why are some older adults quite good at remembering associative information while others are not? What are the (a) structural and functional brain correlates; (b) cognitive, social, and lifestyle factors; and (c) genetic markers accounting for interindividual differences in associative memory functioning? Is there a relationship

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Becker, N., Laukka, E. J., Kalpouzos, G., Naveh-Benjamin, M., Bäckman, L., & Brehmer, Y. (2015). Structural brain correlates of associative memory in older adults. *NeuroImage*, 118, 146–153. doi:10.1016/j.neuroimage.2015.06.002



**Figure 1.** Experimental design and exemplar trials from the item-associative memory task. During encoding, 24 face-scene picture pairs were presented for 4 seconds each. Participants were instructed to memorize both the single pictures and the combinations. At retrieval, three self-paced recognition tasks were administered. In the item memory tasks, subjects saw 16 single pictures; half of the pictures had been studied and the other half served as novel lures. In the associative memory task, subjects saw 16 face-scene pairs. All stimuli had been studied, but half of the pairs were intact and the other half were recombined. Participants were told to indicate whether they had studied a particular item or item pair by pressing the buttons "yes" or "no" on a computer keyboard (adapted from Becker et al., 2015).



**Figure 2.** (a) Hit (H) and false-alarm (FA) rates in the associative memory task across performance groups (poor binders, middle binders, good binders). Error bars represent standard errors around the means. (b) Gray-matter volume correlates of associative memory performance in left dorsolateral prefrontal cortex (BA 8). With increasing hit minus false-alarm rates, gray-matter volume at brain coordinates -3 23 52 increases linearly. BA = Brodmann area (adapted from Becker et al., 2015).

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between associative memory functioning and successful aging? Are older adults with good associative memory performance more similar to younger adults regarding their performance and brain structure/function than older adults with clear associative deficits?

Most of the group's work has been conducted using SNAC-K, an existing large-scale population-based data set that was established at the Aging Research Center, Karolinska Institutet, Stockholm, Sweden (Laukka et al., 2013). A newly established cohort within SNAC-K is of special importance for the group. It consists of 550 60-year-old adults who performed a memory task that allows the separation of associative memory from item memory performance (see Figure 1; Old & Naveh-Benjamin, 2008). In addition, the data set includes (a) data from an extensive cognitive test battery; (b) a large range of demographic, social, and health

information; (c) genotyping of 103 specific single nucleotide polymorphisms (SNPs) related to cognition, vascular disease, longevity, and dementia; and (d) magnetic resonance imaging (MRI) data for a subset of participants.

### Structural Brain Correlates of Associative Memory in Older Adults

Little is known about how volumetric differences in the medial temporal lobe (MTL) and prefrontal cortex (PFC) might contribute to individual differences in associative memory. We investigated regional gray-matter volumes related to individual differences in associative memory in the aforementioned SNAC-K subsample of healthy older adults ( $n = 54$ ; Becker et al., 2015). To differentiate item memory from associative memory, participants intentionally learned face-scene picture pairs before performing a recognition task that included single faces, scenes, and face-scene pairs (see Figure 1). Gray-matter volumes were analyzed using voxel-based morphometry region-of-interest (ROI) analyses. To examine volumetric differences specifically for associative memory, item memory was controlled for in the analyses. Behavioral results revealed large variability in associative memory that mainly originated from differences in false-alarm rates (see Figure 2a). Moreover, associative memory was independent of the individuals' ability to remember single items. Older adults with better associative memory showed larger gray-matter volumes primarily in regions of the left and right lateral PFC (see Figure 2b). These findings provide evidence for the importance of PFC in intentional learning of associations, likely because of its involvement in organizational and strategic processes that distinguish older adults with good, from those with poor, associative memory.

### Dopamine Receptor Genes and Associative Memory in Old Age

In another study on the SNAC-K sample, we investigated to what extent associative memory deficits in old age may be due to disadvantageous genetic predispositions. Animal and human data suggest that dopaminergic modulation may be particularly relevant for associative binding (Li, Naveh-Benjamin, &

Lindenberger, 2005; Papenberg et al., 2017). In this case, we investigated the influence of dopamine (DA) receptor genes on item and associative memory in 525 participants using the same face–scene recognition task as described above (see Figure 1). The effects of SNPs of DA receptor genes D1 (DRD1; rs4532), D2 (DRD2/ANKK1/Taq1A; rs1800497), and D3 (DRD3/Ser9Gly; rs6280) were examined and combined into a single genetic score. Individuals carrying more beneficial alleles, likely associated with greater DA receptor efficacy, performed better on associative memory than older adults with less beneficial genotypes (see Figure 3a). There were no effects of these gene variants on item memory or other cognitive measures, such as short-term memory, executive functioning, fluency, or perceptual speed, indicating a selective association between DA genes and associative memory. By contrast, genetic risk for Alzheimer’s disease (AD) was associated with lower item and associative memory, indicating adverse effects of the APOE  $\epsilon$ 4 gene, which encodes the protein apolipoprotein E, and of a genetic risk score for AD (PICALM, BIN1, CLU) on episodic memory in general (see Figures 3b and 3c). These results confirm that DA may be particularly important for associative memory and that AD-related genetic variations may also influence overall episodic memory in older adults without dementia.

### The Role of Encoding Instructions

Evidence from neuroimaging studies suggests a critical role of the hippocampus and inferior frontal gyrus in the encoding of associations versus items. The influence of study-specific factors such as task instruction on neural substrates of associative memory has not yet been investigated. In this study of younger adults ( $n = 51$ ;  $M_{\text{age}} = 25$  years), we investigated similarities and differences in functional brain correlates for associative and item memory as a function of encoding instruction (Becker, Kalpouzos, Persson, Laukka, & Brehmer, 2017). Participants received either incidental encoding instructions (being asked to judge the animacy of a visually presented item) or intentional instructions (being asked to memorize it), while functional MRI was employed during the encoding of associa-

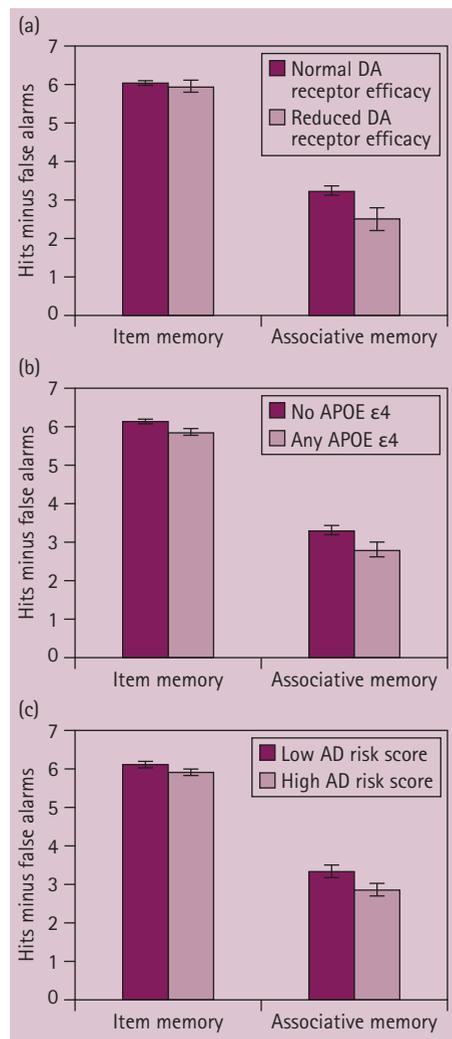


Figure 3. Item and associative memory performance for (a) carriers of genetic predispositions for normal and reduced dopamine (DA) receptor efficacy, (b) noncarriers and carriers of the APOE  $\epsilon$ 4 allele, and (c) persons with a low and high risk score for Alzheimer’s disease (AD) (adapted from Papenberg et al., 2017).

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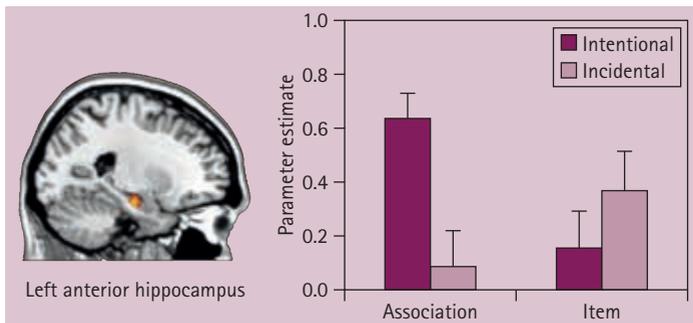
tions (object combinations) and items (single objects). In a subsequent recognition task, memory performance of the participants who received intentional encoding instructions was higher than that of those receiving incidental instructions. Participants remembered more items than associations, regardless of instruction type. Greater brain activation in the left anterior hippocampus was observed for intentionally compared to incidentally encoded associations, although activity in this

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**Figure 4.** Region in the left anterior hippocampus showing a significant task-by-instruction interaction indicating the role of the left anterior hippocampus when intentionally encoding associations, but not when incidentally encoding associations or encoding single items under either instruction type. Mean subject-specific weights of voxels within this region are plotted separately for encoding groups and experimental conditions. Error bars represent standard errors around the means (adapted from Becker, Kalpouzos, Persson, Laukka, & Brehmer, 2017).

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region was not modulated by instruction type for encoded items. Further, greater activity in the left anterior hippocampus and left inferior frontal gyrus was observed during intentional associative compared to item encoding. The same regions were related to subsequent memory of intentionally encoded associations and were thus task-relevant (see Figure 4).

Similarly, connectivity of the anterior hippocampus to the right superior temporal lobe and inferior frontal gyrus was uniquely linked to subsequent memory of intentionally encoded associations. Our study demonstrates differential involvement of the anterior hippocampus in intentional relative to incidental associative encoding. This finding likely means that the intent to remember triggers a specific binding process accomplished by this region.

## Outlook

In future studies, we will investigate age-related differences in structural correlates of associative memory functioning in younger and older adults as well as cognitive, social, health, and lifestyle factors contributing to individual differences in associative binding. The investigation of individual differences in associative memory in older adults is likely to provide useful information for the development of individualized memory training programs that would allow people to make better use of their latent potential, as manifested in larger training gains and transfer effects (e.g., Brehmer, Kalpouzos, Wenger, & Lövdén, 2014).

## Publications 2014–2016

(last update: Spring 2017)

**Becker, N., Kalpouzos, G., Persson, J., Laukka, E. J., & Brehmer, Y.** (2017). Differential effects of encoding instructions on brain activity patterns of item and associative memory. *Journal of Cognitive Neuroscience*, *29*, 545–559. doi:10.1162/jocn\_a\_01062

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**Research Team 2014–2016**

**Gert G. Wagner**

*Postdoctoral Fellow*

Gloria Luong (as of 08/2015: Colorado State University, USA)

*Predoctoral Fellows*

Julia M. Rohrer (LIFE), Julia Sander (LIFE), Nina Vogel (LIFE; as of 02/2017: Umweltbundesamt, Berlin, Germany)

## Overview

As a Max Planck Fellow, Gert G. Wagner is a member of two international research teams, coordinated in Oxford and Amsterdam, that study the impact of genes on different outcomes ("phenotypes"). All of the studies in this context include data from the Berlin Aging Study II (BASE-II; see pp. 160–162). Within the Institute, Ulman Lindenberger and Gert G. Wagner are Co-Principal Investigators of BASE-II. Three of these studies included data on phenotypes from the BASE-II module *Survey Methods and Social Science*, which is coordinated by Gert G. Wagner. The genome-wide association study (GWAS) data were provided by the BASE-II module *Molecular Genetics*, led by Lars Bertram (now University of Lübeck). The studies analyzed anonymized data from some hundred thousand individuals in different countries (BASE-II provides about 2,000 observations).

One of the studies published in *Nature Genetics* (Koellinger, Bertram, & Wagner, 2016; Okbay, Baselmans et al., 2016) shows diverse genetic links between well-being (life satisfaction), depression, and neuroticism. The genetic effects now identified are, however, only responsible for a very small fraction of the heritability of psychological well-being and explain less than 1% of the differences in well-being in the population.

In contrast to medical genetics, where genetic testing can predict the occurrence of some disease with great certainty (e.g., Huntington's disease or certain forms of Alzheimer's disease), genetic research into polygenic traits, such as life satisfaction or well-being, cannot be expected to provide an accurate prediction of outcome. The limited explanatory power of individual genes does not contradict the often substantial heritability of personality traits.

Striking similarities are often found within a family ("she's so much like her grandmother") due to the influence of millions of different genetic variants each of which exerts only extremely small effects when considered separately. When considered jointly, however, these small effects can add up to account for much larger shares of the observed differences across individuals. It is noteworthy that—with the exception of monozygotic twins (who are genetically ~100% identical)—the combination of genetic patterns passed on from parents to children are unique to the particular individual.

Ultimately, psychological well-being is jointly influenced by both genes and environment. To give one illustrative example, suppose that genetic variants influenced how extraverted,

or outgoing, an individual is. Furthermore, suppose that being more extraverted would help a person to make more friends, which in turn would make the person happier. In this example, changes to the intermediate environmental channel—the number of friends—could have drastic effects on the outcome of happiness. Indeed, the genetic association might not be found in environments where a person's number of friends is less strongly related to extraversion, such as in a close-knit community where people tend to know each other personally.

Conversely, social circumstances can increase life satisfaction, even when the gene pool of the population does not change. For example, assume that people react negatively to social inequality. Here, it may be possible to increase the average well-being of the population through a redistribution of resources such as income.

### Replications in Social and Behavioral Science

We live in a time of increasing publication rates and specialization of scientific disciplines. The research community is more and more facing the challenge of ensuring the quality of research and maintaining trust in the scientific enterprise. Replication studies are necessary to detect erroneous research. Thus, the replicability of research is considered a hallmark of good scientific practice. Lately, it has become a key concern for research communities and science policy makers alike. Together with Benedikt Fecher and Mathis Fräbendorf, Gert G. Wagner analyzed perceptions and practices regarding replication studies in the social and behavioral sci-



[www.thessgac.org](http://www.thessgac.org)

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ences. The analyses are based on a survey of almost 300 researchers that use data from the German Socio-Economic Panel Study (SOEP), a multidisciplinary longitudinal multicohort study. We find that more than two thirds of respondents disagree with the statement that replications are not worthwhile because major mistakes will be found at some point anyway. Nevertheless, most respondents are not willing to spend their time conducting replication studies. This situation can be characterized as a “tragedy of the commons”: Everybody knows that replications are useful, but almost everybody counts on others to conduct them.

The most important finding is possibly this: Besides the few replications that are reported, a large majority of these are conducted in the context of teaching. In our view, this is a promising detail: In order to foster replicability, one avenue may be to make replication studies a mandatory part of curricula as well as of doctoral theses. Furthermore, one can argue that replication studies need to be more attractive for researchers. For example, successful replications could be listed in the

authors' publication lists. Vice versa, data sharing needs to receive more recognition, for example, by considering data production and subsequent data sharing as scientific output. On a general note, it can be proposed that the research community should strive toward establishing a market and a culture of data sharing and re-use. Besides the aforementioned implementation in teaching, instruments seem suitable that take the academic reward system into account. For instance, the attractiveness for replication studies would increase if more of these studies were published; especially in times of mega-journals, which are also online, there is no limited-space argument.

An additional option could be increased funding explicitly for replication studies and meta-analyses. Furthermore, positive replications could serve as a proof of research, and therefore successful replications could be listed in the original authors' publication lists. In other words: The scientific community must treat the scientific paradigm more seriously and give credit in all cases where credit is due.

In June 2008, Gert G. Wagner was appointed a Max Planck Fellow at the Institute. Gert G. Wagner is Professor of Economics at the Technische Universität Berlin and since 2011 Member of the Executive Board of the German Institute for Economic Research (DIW Berlin), where the German Socio-Economic Panel Study (SOEP) is located. The Max Planck Society established the Fellow Program to further strengthen research cooperation between its institutes and neighboring universities and other research institutions. The cooperation with Gert G. Wagner, one of the leading researchers running the SOEP, allows researchers at the MPI for Human Development to work in close cooperation with the SOEP Group at DIW Berlin. Of particular interest is the “SOEP Innovation Sample” which, for example, was used by Ralph Hertwig for the collection of observational data. Ulman Lindenberger and Gert G. Wagner are two Co-Principal Investigators of the Berlin Aging Study II (BASE-II). Gert G. Wagner is a faculty member of the International Max Planck Research School on the Life Course (LIFE) as well. Gerd Gigerenzer and Gert G. Wagner both serve on the “Advisory Council for Consumer Affairs.”

In the coming years, Ralph Hertwig and Gert G. Wagner will be running the project “Origins and determinants of malleable risk preferences” together, which is funded by the Max Planck Society (2017–2022).

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## Emeritus Research Group of Jürgen Baumert

Jürgen Baumert's work focuses on the reform of the Berlin secondary school system, the relationship between students' educational resources and their life course, the development of teachers' professional competence, and the potential of bilingual alphabetization in multicultural societies. These research projects are being conducted in cooperation with the German Institute for International Educational Research (DIPF; Kai Maaz), the Leibniz Institute for Science and Mathematics Education at the University of Kiel (IPN; Olaf Köller), the Christian-Albrechts-Universität zu Kiel (Jens Möller), and the Mercator Institute at the University of Cologne (Michael Becker-Mrotzek).



### Reform of the Secondary School System in Berlin and Its Impact on Academic and Vocational Careers (BERLIN Study)

This study aims to evaluate the recent reform of the Berlin secondary school system and its long-term effects on students' individual development and career patterns. The study has a quasi-experimental, longitudinal design. It is being conducted in cooperation between the MPI for Human Development, the DIPF, and the IPN, and is jointly funded by the state of Berlin and the Jacobs Foundation.

Over the past few years, the secondary school systems of many German federal states have undergone major reforms. The traditional three-track system consisting of vocational-track *Hauptschule*, intermediate-track *Realschule*, and academic-track *Gymnasium* is currently no longer implemented in any of the 16 states. Instead, most states have switched to a two-track system with just one type of secondary school alongside the academic-track *Gymnasium*. Students at these new "integrated secondary schools" can work toward a basic or an intermediate school-leaving certificate. In many states, integrated secondary schools also offer a direct route to the *Abitur*, the general higher education entrance qualification that was previously accessible only to *Gymnasium* students.

In Berlin, structural reforms of the secondary system were implemented at the start of the 2010/11 academic year, with vocational-track, intermediate-track, and comprehensive schools being fused to become integrated secondary schools. Students at this new school type have access to all school-leaving qualifications, including the *Abitur*. The new integrated secondary schools provide compulsory full-day education, place a stronger em-

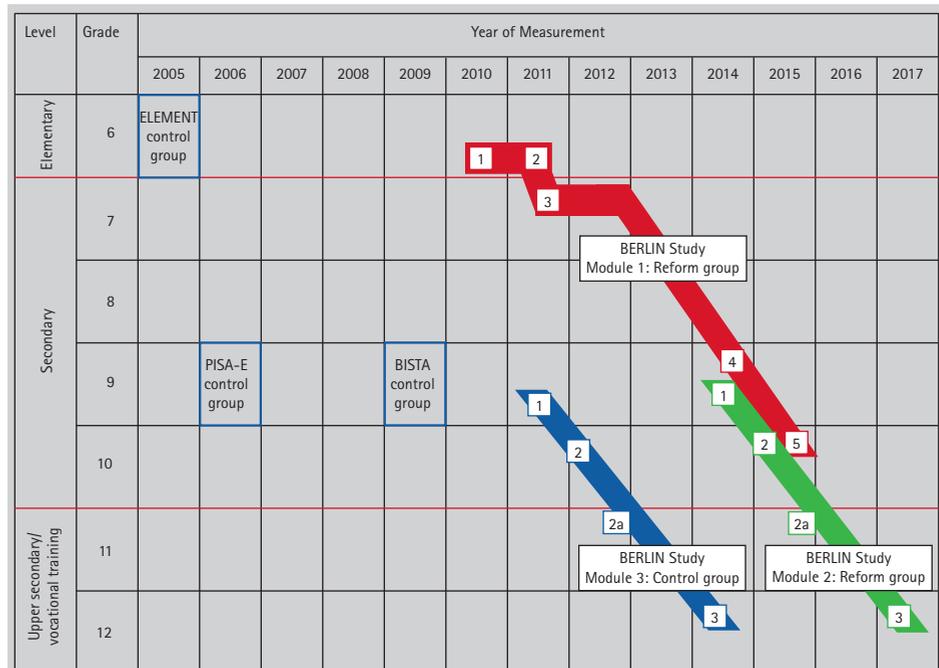
phasis on career orientation (dual learning in day-release programs), and do not implement grade retention. The goals of the structural reforms are primarily to increase the number of students graduating with an intermediate school-leaving certificate or an *Abitur* and to reduce the numbers leaving school without qualifications. At the same time, the reforms were intended to weaken the link between family background and educational outcomes. The procedures for transition from elementary to secondary school have also been modified. The main change concerns procedures for admission to individual secondary schools. In principle, parents in Berlin have a free choice of secondary schools.

### Design of the BERLIN Study

The BERLIN Study was designed to investigate the effects of these structural reforms on students' learning outcomes and educational careers. It investigates a specific group of students: the second cohort to be educated within the new structures and, at the same time, the first to have experienced the new transition procedures. The study will track these students from the end of elementary school (grade 6) until the transition to vocational or upper secondary education. The study comprises two stages: Stage 1 (Module 1) focuses on the transition from elementary school to lower secondary education; Stage 2 (Modules 2 and 3) examines educational outcomes at the end of lower secondary education and the transition to vocational and upper secondary education. Both stages involve an experimental and a control group, with the two experimental groups overlapping at the end of lower secondary education (see Figure 1).

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Note. BERLIN Study Module 1: Stage 1 of the BERLIN Study, reform cohort; BERLIN Study Module 2: Stage 2 of the BERLIN Study, reform cohort; BERLIN Study Module 3: Stage 2 of the BERLIN Study, control cohort; ELEMENT: ELEMENT Study, will provide control data for the first assessment in Module 1 of the BERLIN Study; PISA-E: Berlin data from PISA Cross-State Comparison, will provide control data for the first assessment in Modules 2 and 3 of the BERLIN Study; BISTA: Educational Standards in Berlin, will provide control data for the first assessment in Modules 2 and 3 of the BERLIN Study.

Figure 1. Design of the BERLIN Study.

© MPI for Human Development

### First Report on the BERLIN Study

The first report on the BERLIN Study's findings focused on three main questions:

- (1) *Stakeholders' Evaluations of the Reforms.* The move to a two-track system was welcomed by the large majority of teachers and school principals and by the majority of parents. All stakeholders applauded the fact that both tracks now offer the same qualifications (including the *Abitur*). The same applied to the stronger focus on career orientation and dual learning and to the provision of full-day education in all integrated secondary schools.
- (2) *Social Disparities at the Transition From Elementary to Secondary Education.* The alarming impact of social background at the transition from elementary to secondary education in Germany has been a topic of considerable debate. To what extent is the choice of secondary school type impacted not only by a student's academic achievement but also

by family background characteristics (what Boudon termed "secondary background effects")? Our analyses revealed comparatively positive results for the state of Berlin. In contrast to many other assessments, the BERLIN Study found that social background did not have any effect above and beyond academic achievement (grades and test scores) on the secondary school track recommendation.

- (3) *The Choice of Individual Secondary School in the New Transition System.* Findings showed that 84% of students were offered a place in the school of their choice (92% of those at *Gymnasium* schools, 79% of those at integrated secondary schools). Whether a student was offered a place at the school of his or her choice depended solely on his or her academic achievement (in terms of grade point average at elementary school); family background proved to have no additional effect. The results also revealed marked variations in demand for

places at individual schools, with more pronounced differences in the demand for places at integrated secondary schools than at *Gymnasium* schools. Of the integrated secondary schools, those with an on-site upper secondary center were in highest demand.

#### *Second Report on the BERLIN Study*

The second report on the BERLIN Study concentrated on cross-sectional findings on the reforms. In a quasi-experimental design, two cohorts of grade 9 students and students aged 15 years old were compared before and after the reforms. The key findings of the report can be summarized as follows:

- (1) In Berlin, the secondary school system was transformed from a five- to a two-track system in a single step by merging and reorganizing nonacademic-track secondary schools. Both of the tracks now in place—*Gymnasium* and integrated secondary schools—allow students access to all school-leaving qualifications, including the *Abitur*, though the tracks have different curricular focuses and timetables (at integrated secondary schools, it takes a year longer to obtain the *Abitur*). These structural reforms form an important basis for the future-oriented development of Berlin's secondary school system, though traditional patterns are, to some extent, still apparent.
- (2) Students' educational biographies are now smoother. The abolition of grade retention means that biological age and school grade are now better aligned. With the exception of transitions to and from the *Gymnasium* track, moreover, there is no longer any need for particularly high- or low-achieving secondary students to switch between tracks.
- (3) In terms of educational outcomes, the Berlin secondary system has remained extraordinarily stable—the reforms have had very little bearing on patterns of achievement. There is no evidence for weaker students or particularly talented students being afforded more individualized instruction and support. It seems likely that the curricular and staffing measures accompanying the reforms need longer to take effect.
- (4) Patterns of social and ethnic stratification have remained largely unchanged. Even

after the reforms, the Berlin school system is characterized by high social disparities in educational attainment.

- (5) Educational aspirations have risen since the reforms were implemented, and the new integrated secondary schools opened up another direct route to higher education. Accordingly, there has been an increase in the number of students entering the academic strand of upper secondary level, which qualifies for higher education.
- (6) These findings of rising educational aspirations coupled with stable levels of achievement indicate that there will be difficulties with maintaining standards, potentially leading to new problems of distributional justice.
- (7) The restructuring of a school system does not mark the end of a reform process, but its beginning. The real challenges of optimizing students' developmental processes are located in the nature and quality of the work done by schools and in the professional qualification of teaching staff.

#### **Schooling and Individual Development in Adolescence and Adulthood (BIJU)**

This longitudinal study, which was initially entitled *Learning Processes, Educational Careers, and Psychosocial Development in Adolescence and Young Adulthood*, was initiated in 1991. The sample of school classes comprises some 8,000 students from 212 secondary schools of all types in the states of Berlin, Mecklenburg-West Pomerania, North Rhine-Westphalia, and Saxony-Anhalt. The seventh wave of data collection took place in 2009/10, when most participants were 32 years old. The longitudinal study is now being continued in cooperation with the DIPF (Kai Maaz), the IPN (Olaf Köller), and the University of Michigan at Ann Arbor (Kai S. Cortina). The study is funded by the Strategic Innovation Fund of the President of the Max Planck Society.

The BIJU study comprises five components:

- (1) providing institutional and individual baseline data on the integration of the East and West German educational systems since 1991;
- (2) analyzing domain-specific learning as a function of personal resources and institutional opportunity structures;

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(3) analyzing long-term trajectories of psychosocial development in adolescence and young adulthood;

(4) analyzing the transition from school to vocational training or university;

(5) analyzing the transition to the labor market and to starting a family.

Data collection began with a survey of the main cohort (longitudinal cohort 1) in the 1991/92 school year, during which data were gathered from grade 7 students at three measurement points. The first point of measurement coincided with the transformation of the unitary school system of the former East Germany to the tracked system adopted from West Germany. The fourth wave of data collection was conducted in spring 1995, when the main cohort students were in the final grade of lower secondary school. The fifth wave took place in spring 1997, when participants were either in vocational or upper secondary education. The sixth wave of data collection, conducted in 2001, focused on how students had mastered the transition from school to university or from vocational education to the labor market. The seventh wave of data collection in 2009/10 focused on occupational position and partnership. The eighth wave of data collection will take place in 2017, by which time participants will be 38 years old, and will concentrate on occupa-

tional careers, family life, and social and cultural integration. Our analyses are currently focusing on components (3), (4), and (5).

## Bilingual Alphabetization in Multicultural Societies: Evaluation of Berlin's State Europe Schools (EUROPA Study)

The key objective of this new study, which was initiated in 2013, is to examine whether bilingual alphabetization in so-called two-way immersion is a suitable instrument for reducing the educational disadvantage of immigrant children. Drawing on a longitudinal, extended evaluation of the Berlin's State Europe Schools (SESBs), we aim to derive benchmarks for the outcomes of two-way immersion for children from German-speaking and non-German-speaking families. In addition, we will test the hypothesis that positive transfer occurs from the first to the second language as long as a critical threshold of language proficiency has been reached, and the hypothesis that children who learn to read and write in two languages are at a general advantage in terms of the development of executive functions. The study has a quasi-experimental design and includes a longitudinal component at elementary school level (see Figure 2). It is being conducted in cooperation with the Christian-Albrechts-Universität zu Kiel (Jens Möller), the Leibniz Institute for

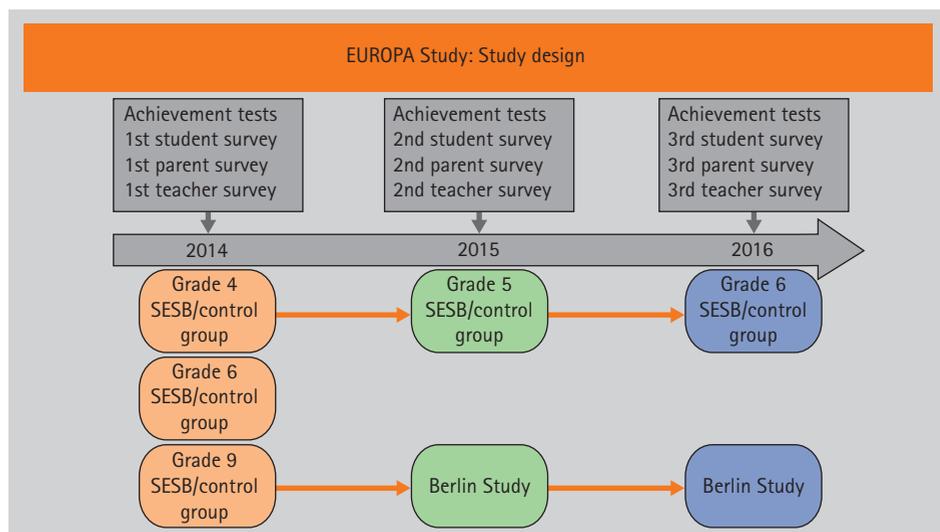


Figure 2. Design of EUROPA Study.

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Science and Mathematics Education (IPN) in Kiel (Olaf Köller), and the Mercator Institute for Language Training and German as a Second Language at the University of Cologne (Michael Becker-Mrotzek). It is funded by the state of Berlin and the Mercator Stiftung.

#### *Cross-Sectional Findings*

*Mission and Objectives of SESBs.* Berlin's SSESBs implement two-way immersion with the aim of developing students as balanced bilinguals. The key objective of SESBs is for students to become competent in German and a partner language, without that being to the detriment of their achievement in the other subjects. There are currently nine language programs at different sites: Students are taught in German and either English, French, Greek, Italian, Polish, Portuguese, Russian, Spanish, or Turkish. The languages have equal standing; half of the subjects are taught in German, the other half in the partner language.

*The Student Population.* The proportion of students with an immigration background is much higher in SESBs than in Berlin's regular monolingual schools. Most students at SESBs grow up bilingually. In some SESBs, the socioeconomic background of the student population is higher than in regular schools, but cognitive ability is—if at all—only slightly higher. Many students at the schools with the partner languages English, French, Portuguese, and Spanish do not come from the respective European countries, but from a range of countries in Africa and Central and Southern America, where the partner language is an official language and serves as a lingua franca.

*Findings on Student Achievement.* Overall, the findings showed that, at both elementary and lower secondary level, the performance of SESB students in reading comprehension, mathematics, and science was neither higher nor lower than that of their peers in the Berlin comparison groups when testing was conducted in German. In other words, despite learning to read and write in two languages and being taught in both of those languages, the SESB students showed no developmental disadvantages in subjects taught in German. These findings did not change when we con-

trolled for the social, educational, and cognitive selectivity of the SESBs. Moreover, SESB students performed much better in English. Two-way immersion thus lays a solid basis for learning a further foreign language. However, there was no evidence for immigrant students receiving more individualized instruction catering to their specific needs.

In the context of the SESB evaluation study, grade 4 and 9 students were also tested in the partner language, using reading comprehension and science tests from international studies. This approach made it possible to compare the achievement of the SESB sample with that of their peers in countries where the partner language is the language of instruction. At first glance, the analyses confirmed that grade 4 students have not yet reached the achievement level of L1 speakers from the partner countries when it comes to reading comprehension in the partner language. However, a good two-thirds of them have a solid basic command of the language. In fact, almost half of them reached a level typical of that in the partner countries. Similar patterns of results emerged for grade 9 students at the end of lower secondary level.

*Social and Cultural Integration.* Findings on the social integration of students with different national and cultural backgrounds at SESBs paint a positive picture. Among grade 9 students or 15-year-olds in the inclusive setting of a bilingual institution, there was widespread endorsement of equality of cultures. Only a minority of students with a German background voiced exclusionary attitudes; among students from immigrant families, such attitudes decreased systematically from one generation to the next.

Social interaction analyses conducted in grade 4 indicate that the integration of children from linguistic and cultural minority groups is more successful at SESBs than in the regular Berlin school types. In regular classes, minority students—especially those who grew up monolingually in a language other than German—lagged behind in terms of popularity. The same does not hold at SESBs. Students who grew up speaking German only, who represent a minority in SESBs, are more open to members of other language groups.

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(last update: Spring 2017)

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(last update: Spring 2017)

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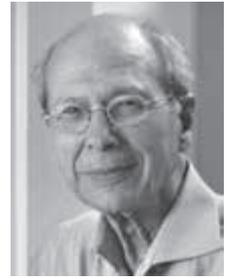
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## Karl Ulrich Mayer: Publications 2014–2016

(last update: Spring 2017)

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## International Max Planck Research School on the Life Course (LIFE)



International Max Planck  
Research School  
on the Life Course

[www.imprs-life.mpg.de](http://www.imprs-life.mpg.de)

Studying the development of human behavior from infancy to old age is at the heart of the LIFE graduate program. LIFE takes an integrative and interdisciplinary approach to identifying, understanding, and improving the mechanisms and conditions that shape the human life course. It actively promotes international networking and communication as an integral part of graduate training. The Berlin-based fellows are recruited from all over the world (e.g., Bulgaria, Iran, Ireland, Poland, Portugal, etc.). In addition, four LIFE sites in three countries (Germany, the United States, Switzerland) located on either side of the Atlantic guarantee a graduate education with a strong emphasis on international exchange and collaboration.

The target groups of the Research School are graduate students who have completed their master's degree, share an interest in the human life course, and intend to pursue a doctorate in one of the disciplines represented in LIFE (biology, computer science, economics, educational science, neuroscience, psychology, and sociology). As a collaborative Research School, LIFE offers students a unique educational experience: academic training in their area of specialization that is enriched by interdisciplinary and international perspectives.

The training program involves seminars at the participating institutions, a series of fall and spring academies, and collaborative supervision of research training. It also includes opportunities for research abroad at a cooperating institution. Seventeen fellows (six from Berlin, one from the University of Virginia,

three from the University of Michigan, and seven from the University of Zurich) made use of this international research option in the reporting period.

The key components of the LIFE program are semi-annual 1-week academies attended by fellows and faculty from each site. Each year, one academy takes place in spring and the other in fall; hence, six such academies took place during the period of reporting. The University of Virginia in Charlottesville organized the LIFE Spring Academy 2014, while the Fall Academy 2014 took place in Berlin. In 2015, the Spring Academy was held at the University of Michigan in Ann Arbor with the Fall Academy being organized by the University of Zurich at Marbach Castle, Germany. The 2016 Spring Academy was held at the University of Virginia, while the Fall Academy was organized by the MPI for

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Figure 1. Participants from all four LIFE sites during the LIFE Fall Academy 2016 at the MPI for Human Development.

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Human Development in Berlin. The next academy is scheduled to take place in Ann Arbor in May 2017. Each fellow participates in four academies. Typically, about 30 fellows attend a given academy. Most of them present their dissertation research either as a poster or in a talk, with ample time for discussion with faculty and co-fellows. In addition, roughly 25 faculty members from all sites as well as a few local alumni participate in each academy in addition to one or two guest speakers from other institutions. Each time, the graduating alumni also join the group to celebrate their LIFE Commencement. The IMPRS LIFE Newsletter, which appears three times a year, provides a forum for scientific and collegial exchange across sites.

*Table 1. International LIFE Community (as of 03/2017)*

	Berlin	Michigan	Virginia	Zurich
Faculty	37	32	21	16
Fellows	29	16	9	18
Alumni	84	40	33	22

After a highly positive evaluation from a board of four external reviewers appointed by the Max Planck Society, the Society decided to continue to support the LIFE program for a third 6-year funding period starting in 2014.



*Figure 2. LIFE Commencement 2014, Hahn-Hörsaal at the Harnack-Haus in Berlin-Dahlem.*

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In addition to the Academies, each participating university offers courses reflecting the special profile of its graduate programs and selects a subset of fellows for the added specialization provided by LIFE. The Berlin approach is to start the program with an intense 3-day reading class on the foundations of lifespan research to ensure that LIFE fellows with different disciplinary backgrounds share a common scientific knowledge base. Furthermore, LIFE Berlin offers weekly seminars at the MPI for Human Development, taught throughout the academic year by a diverse group of faculty from the three Berlin institutions as well as additional workshops, particularly on methods and on academic presentation skills. Several courses are shared with the other LIFE sites via advanced video-conferencing technology (Access Grid).

Table 2. LIFE Seminars and Workshops 2014–2016, Berlin

Semester	Topic	Instructor(s)
Winter 2013/14	Social and Behavioral Gerontology Introduction to Dynamical Systems Analysis Multivariate Data Analysis Structural Equation Modeling (SEM) and the Analysis of Change With Mplus	Clemens Tesch-Römer (DZA) and guests Steven M. Boker (UVa) via Access Grid Steven M. Boker (UVa) via Access Grid Andrea Hildebrandt, Jenny Wagner (HU)
Summer 2014	Introductory Workshop "Foundations of Lifespan Research" Adaptive Rationality Missing Data: Introduction to the Analysis of Incomplete Data Sets Data Analysis Beyond P-Values: A Practical Introduction to Bayesian Statistics	Berlin LIFE faculty and guests Ralph Hertwig (MPIB) and guests Tenko Raykov (Michigan State University) Stefan Herzog (MPIB)
Winter 2014/15	Methods in Research on Human Development Introduction to Structural Equation Modeling Introduction to R Academic Writing Academic Presentation Training	Ulman Lindenberger (MPIB) and guests Steven M. Boker (UVa) via Access Grid Martin Schultze (FU) Ulman Lindenberger (MPIB) Steve Weir (FU)
Summer 2015	Introductory Workshop "Foundations of Lifespan Research" Education Across the Lifespan	Berlin LIFE faculty and guests Petra Stanat (HU) and guests
Winter 2015/16	Philosophy of Science Academic Presentation Training	Lena Keller (HU) and guests Steve Weir (FU)
Summer 2016	Introductory Workshop "Foundations of Lifespan Research" Fellows' Project Presentations Alternative Careers Academic Writing	Berlin LIFE faculty and guests Chaired by Berlin LIFE alumni Chaired by Berlin LIFE fellows and alumni Ulman Lindenberger (MPIB)
Winter 2016/17	Developmental Theory and Methodology of the Lifespan MATLAB-based EEG Analysis Academic Presentation Training	Ulman Lindenberger (MPIB) and guests Markus Werkle-Bergner (MPIB) Steve Weir (FU)
Freie Universität Berlin (FU), German Centre of Gerontology (DZA), Humboldt-Universität zu Berlin (HU), MPI for Human Development (MPIB), University of Virginia (UVa).		

Table 3. Berlin LIFE Fellows' Dissertation Projects (as of 03/2017)

Name	Institution	Dissertation Project
Janne Adolf	MPIB	Investigating the dynamics of intra-individual emotional functioning
Anne Böger	DZA	Feeling connected in times of social loss: Age-related dynamics in the emergence of loneliness from middle adulthood to old age
Rasmus Bruckner	FU	Age differences in adaptive learning: A neuro-computational approach
Oisin Butler	MPIB	Structural and functional plasticity in response to stressful life events
Tiago Cabaço	HU	Within- and between-subject dynamics of cognitive processes
Martin J. Dahl	MPIB	Lifespan age differences in rhythmic neural activity: Anatomical foundations and functional implications
Charles C. Driver	MPIB	Dynamic models and the development of subjective well-being
Philipp Gerlach	MPIB	The social framework of individual decisions
Johanna M. Grosse Rueschkamp	HU	The up-regulation of positive emotions: Individual differences at multiple levels of analysis
Katinka Hardt	HU	Factor score prediction in dynamic models of change
Stefan Heß	MPIB	The role of cognitive processing units in writing and their emergence during primary school
Anna Karlsson	MPIB	Age differences in the use and reinstatement of contextual information in episodic memory
Lena Keller	FU	Profiles in students' achievement and achievement motivation: Gender differences, top performers, and life outcomes
Neda Khosravani	MPIB	How to train fluid intelligence in children: Comparing top-down and bottom-up approaches
Maike M. Kleemeyer	MPIB	Effects of physical activity on cognitive performance across the lifespan
Corinna Laube	MPIB	Developmental changes in intertemporal choice
Judith Mangelsdorf	FU	What makes a "thrivor"? Psychological growth processes following major life events with high emotional valence
Felix Molter	FU	The effect of attention on decision making across the adult lifespan
Toni Muffel	HU	Measuring and modulating post-stroke brain plasticity
Swantje Müller	HU	Dynamics of adaptation in very old age: Personality, coping and well-being
Elisa Oppermann	FU	The role of motivation in early mathematics and science education
Julia M. Rohrer	DIW/MPIB	The individual development of "second-generation immigrants" across different nations
Julia Sander	DIW/MPIB	Personality and social network development across the lifespan
Karola Schlegelmilch	MPIB	"Grass or gravel": Influences on the categorization of naturalistic structures in infancy and childhood
Verena R. Sommer	MPIB	Representational similarity of memory encoding and retrieval across the adult lifespan
Juliane Stahl	DIW	Systematic selection into childcare facilities of varying quality and subsequent impacts on maternal employment
Mila Staneva	DIW	Studying and working: Educational and labor market returns of employment during higher education
Aleksandra Włodarczyk	MPIB	Response to naturalistic threats in infancy and early childhood
Sara Zocher	CRTD	Epigenetics of experience-dependent brain individualization

Center for Regenerative Therapies Dresden (CRTD), German Centre of Gerontology (DZA), German Institute for Economic Research (DIW), Freie Universität Berlin (FU), Humboldt-Universität zu Berlin (HU), MPI for Human Development (MPIB).

Table 4. LIFE Faculty Members at the MPIB or with MPIB Affiliation (as of 03/2017)

Name	Center	Position
Jürgen Baumert	Educational Research	Director emeritus
Annette Brose	Lifespan Psychology	Adjunct Researcher
Gerd Gigerenzer	Adaptive Behavior and Cognition	Director
Ralph Hertwig	Adaptive Rationality	Director
Simone Kühn	Lifespan Psychology	Adjunct Researcher
Ulman Lindenberger	Lifespan Psychology	Director
Thorsten Pachur	Adaptive Rationality	Senior Researcher
Timothy J. Pleskac	Adaptive Rationality	Senior Researcher
Michaela Riediger	Heisenberg Research Group "Socioemotional Development and Health Across the Lifespan"	Group Leader
Myriam C. Sander	Minerva Group, Lifespan Psychology	Group Leader
Florian Schmiedek	Lifespan Psychology	Adjunct Researcher
Sascha Schroeder	MPRG Reading Education and Development (REad)	Group Leader
Yee Lee Shing	Lifespan Psychology	Adjunct Researcher
Wouter van den Bos	Adaptive Rationality	Researcher
Manuel C. Voelkle	Lifespan Psychology	Adjunct Researcher
Timo von Oertzen	Lifespan Psychology	Adjunct Researcher
Gert G. Wagner		Max Planck Fellow
Markus Werkle-Bergner	Lifespan Psychology	Senior Researcher
Annie E. Wertz	MPRG Naturalistic Social Cognition	Group Leader

Note that Annette Brose, Thorsten Pachur, Yee Lee Shing, and Markus Werkle-Bergner are LIFE alumni, that is, they completed their dissertations within LIFE.



## International Max Planck Research School for Moral Economies of Modern Societies (MEMS)

The International Max Planck Research School for Moral Economies of Modern Societies was founded in 2013 as a collaboration of the Max Planck Institute for Human Development, the Humboldt-Universität zu Berlin, the Freie Universität Berlin, and the Technische Universität Berlin. Each year, up to six PhD candidates are admitted in a competitive selection process to the comprehensive 4-year PhD program of the IMPRS Moral Economies.

### Faculty Members

*Ute Frevert,*  
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*Stefanie Schüler-  
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on Antisemitism,  
Technische Univer-  
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### Research Coordinator

*Monika Freier,*  
MPI for Human  
Development

The PhD projects analyze the origins of moral values and their influence, impact, and contestation in the economic, social, political, and cultural spheres. Candidates from a range of disciplinary backgrounds are invited to apply to the IMPRS Moral Economies, where they will pursue a PhD in History on a topic based on their personal research interests. While the theoretical focus on moral economies is the binding element, the projects cover a wide range of topics that encompass a variety of geographical regions, political systems, languages, communities, and cultures. The research also focuses on the ways in which values and emotions reinforce or contradict one another in modern societies. The projects of the PhD candidates that have been admitted to the IMPRS Moral Economies primarily focus on the 19th and 20th centuries, but individual research projects also extend to the 18th century or include approaches to contemporary history. This diversity encourages PhD candidates to find common research themes across cohorts, such as changing cityscapes and debates on the nature of modernity, transformations in political landscapes, and transnational relationships and movements, to name a just few.

### Offering a Comprehensive Study Program

The graduate training program of the IMPRS Moral Economies is divided into three main phases. Seminars on theory and methodology during the coursework phase (semesters 1–3) provide a common context for PhD candidates from different academic backgrounds. Further seminars and workshops on different aspects of moral economies enable the PhD candidates to refine their research interests. During this phase, PhD candidates are also encouraged to begin collecting archival material. The empirical phase (semesters 4–5) is

primarily devoted to the evaluation of source material from archives and libraries and/or to fieldwork. PhD candidates then compose their dissertations during the completion stage (semesters 6–8). Detailed comments from peers and supervisors help them fine-tune their texts and prepare for the thesis defense. The program's flexibility allows PhD candidates to shape seminars and reading groups according to their common research interests. The introductory seminars for PhD students pursue a threefold aim: to ensure that all PhD candidates have a common foundation, to give them a firm grounding in the current theoretical approaches in history, and to forge a group identity and an atmosphere of intellectual exchange. Colleagues from the Center for the History of Emotions frequently teach and participate in these seminars and share their insights on questions of methodology, such as on how to conduct interviews for oral history projects and how to evaluate textual and audiovisual source material. These seminars have proven to be highly engaging and have received very positive evaluations from the PhD candidates. Seminars offered by the IMPRS focus on how emotions and morality are connected, under what conditions moral values historically emerge and change, and if



Figure 1. PhD candidates of cohort IV.

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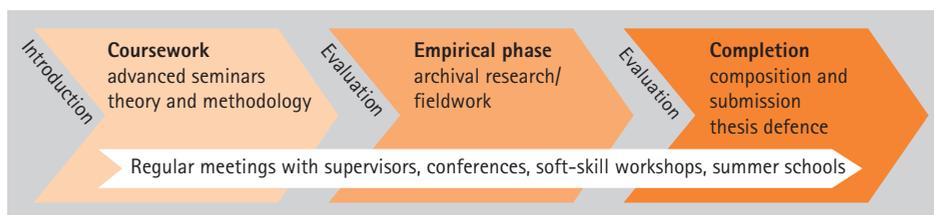


Figure 2. The structured PhD program of the IMPRS Moral Economies seeks to create an ideal environment for young academics to pursue their research interests and complete their PhD project within the course of 4 years.

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values (and virtues) have to be bolstered by a certain emotional intensity in order to become internalized and practiced. Furthermore, PhD candidates build up their own academic networks, participate in reading groups at the Center for the History of Emotions, and attend courses and workshops at the history departments of the Freie Universität and Humboldt-Universität, as well as at the Center for Research on Antisemitism at the Technische Universität Berlin.

Every year, the IMPRS Moral Economies organizes a retreat for PhD candidates of all cohorts. The retreat gives PhD candidates and supervisors the opportunity to reevaluate the progress of the dissertation project at crucial stages in the writing process. After the first year, the PhD candidates present a revised version of their dissertation outline. After the second year, they submit the first chapter of their dissertation. After the third year, they hand in a comprehensive report on their archival research as well as their second chapter.



Figure 3. Critically assessing theoretical questions and creatively developing new approaches to moral economies is central for the study program at the IMPRS Moral Economies.

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In addition to advanced historical training, the IMPRS Moral Economies also offers professional training opportunities. Courses on presentation skills and academic writing in English are exclusively tailored to the specific needs of PhD candidates. Furthermore, the IMPRS Moral Economies is associated with the Dahlem Research School as well as the Humboldt Graduate School, both of which offer a variety of academic and professional training and coaching programs.

### Fostering International Collaborations

Summer schools and international workshops at the IMPRS Moral Economies allow for collaborations with other international research groups. These collaborations give our PhD candidates opportunities to interact with young academics from all over the world and present the research of the IMPRS to an international audience. Fostering international connections is one of the main goals of the IMPRS Moral Economies.

In 2014, the IMPRS Moral Economies organized its first summer school in cooperation with CONCEPTA, an international network of conceptual historians. Twenty-five PhD candidates from 18 different countries explored how moral values and emotions have been conceptualized in different languages and cultures and how a transnational, translational perspective can benefit those working on conceptual history. PhD candidates also asked how historians might expand the domain of conceptual history beyond language in order to account for the multisensorial nature of experience and the multimedial nature of its expression. PhD candidates in History and related disciplines also held discussions with

renowned scholars in the field and presented their own research.

The second summer school, or rather autumn school, took place in September 2014 at St. John's College, Cambridge. The discussion topics spanned the early modern to the modern period and encompassed a range of disciplinary approaches, drawing on political history, intellectual history, material culture,

and cultural history. Twenty young scholars from Berlin and the UK, who are working in History and related disciplines, took part in this program. Discussions on the connections between morality and emotions in cultural productions and social encounters especially focused on the interplay between cultural and social norms, emotions, subjectivities, and the material world. The program consisted of

Table 1. Academic Events at the IMPRS Moral Economies

Semester	Topic	Keynote/Lecturers
Winter 2013/14	Inauguration of the IMPRS Moral Economies	David Nirenberg (University of Chicago)
	Seminar: Introduction to Moral Economy and the History of Emotions	Ute Frevert (MPIB), Margrit Pernau (MPIB), Monika Freier (MPIB)
	Seminar: Current Approaches in the Theory and Methodology of History	Researchers at the Center for the History of Emotions
Summer 2014	Seminar: Moral Economies in the Modern Life-Cycle	Stephanie Olsen (MPIB)
	IMPRS Peer Colloquium	
	Retreat of the IMPRS Moral Economies in cooperation with the Center for the History of Emotions	Ute Frevert (MPIB) and researchers at the Center for the History of Emotions
Winter 2014/15	Summer School: Concepts, Language and Beyond. Emotions between Values and Bodies	Jan Ifversen (Aarhus University), Helge Jordheim (University of Oslo), Rochona Majumdar (University of Chicago), Margrit Pernau (MPIB)
	Seminar: Introduction to Moral Economy and the History of Emotions	Ute Frevert (MPIB), Monika Freier (MPIB)
	Seminar: Current Approaches in the Theory and Methodology of History	Researchers at the Center for the History of Emotions
Summer 2015	NYLON Graduate Student Conference	
	Seminar: Gender, Self and Morality in Criminal Legal Cultures	Laura Kounine (MPIB), Gian Marco Vidor (MPIB)
	Seminar: North, South, East, West—Cardinal Directions as Cultural Code in Modern History	Paul Nolte (FU Berlin)
	IMPRS Peer Colloquium	
Winter 2015/16	Summer School on the History of Emotions	Christopher Clark (University of Cambridge), Ute Frevert (MPIB), Laura Kounine (MPIB), Ulina Rublack (University of Cambridge)
	Seminar: Introduction to Moral Economy and the History of Emotions	Ute Frevert (MPIB), Monika Freier (MPIB)
	Seminar: Theory and Methodology of History	Researchers at the Center for the History of Emotions
Summer 2016	Seminar: Happy Objects and Objects of Happiness—Historical, Political and Economic Perspectives	Edgar Cabanas Diaz (MPIB)
	Seminar: Vengeance—States, Violence and Law in World History	Stephen Cummins (MPIB)
	Seminar: Alcohol and Drugs in Modern History	Pavel Vasilyev (MPIB)
	IMPRS Peer Colloquium	
	Course: Academic Writing in English	Roisin Cronin
	German History Workshop	Jennifer Allen (Yale), Ute Frevert (MPIB), Stefan-Ludwig Hoffmann (UC Berkeley)
	Conference: A System Without Anger and Fondness? Emotions in the Age of Bureaucracy	Timon de Groot (MPIB), Thomas Rohringer (MPIB)
Winter 2016/17	Seminar: Introduction to Moral Economies	Monika Freier (MPIB)
	Course: Academic Writing in English	Roisin Cronin



Figure 4. Summer School at St. John's College, Cambridge University.

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intensive text discussions and opportunities for the participants and faculty members to present their own research.

In July 2016, a workshop organized with the UC Berkeley History Department brought together PhD candidates and faculty from Berlin, the UC Berkeley, Yale, and the University of Michigan. Focusing on German and US history, this workshop strengthened the cooperation between the two institutions. As a result, a graduate conference is planned for 2017 that will focus on different aspects of moral economies in the modern world. Possible topics include the moral economies of crime and punishment, risk and nuclear power, markets and neoliberalism, sexual education and censorship, migration and diaspora communities, international humanitarian law, and colonial population control.

PhD candidates of the IMPRS Moral Economies can apply to spend one semester as "nondegree visiting students" or "visiting researchers" at the University of Chicago or the University of California, Berkeley. PhD candidates participate in classes, workgroups, and other academic events at the host university. Depending on the individual work plan of the IMPRS candidates and their dissertation topic, they utilize their stay for archival research and for discussing their projects with professors and peers. So far, Yaara Bengier, Tobias Bernet, and Till Großmann have participated in the exchange program with the University of Chicago, while Sören Brandes, Paul Franke, Timon de Groot, and Marvin Menniken each spent a semester at the UC Berkeley.



Figure 5. Professors, postdocs, and PhD candidates enjoyed the German History Workshop, coorganized by the UC Berkeley and the IMPRS Moral Economies.

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### Strengthening Academic Career Paths

In the humanities, and especially in a field like history, PhD candidates traditionally focus only on their own projects, developing their own research methodology. The IMPRS Moral Economies, however, seeks to create an atmosphere that fosters the exchange of ideas among young academics through reading and discussion groups and that enables candidates to establish academic networks with other PhD students. A key role in this process is the organization of workshops and conferences in collaboration with other young academics.

In March 2015, Yaara Bengier and Till Großmann organized the 13th Annual NYLON Conference in collaboration with the Humboldt-Universität zu Berlin, the London School of Economics and Political Science, and New York University. NYLON is a network of doctoral and postdoctoral researchers from New York, London, and Berlin that brings together scholars who share an interest in culture and qualitative research methods. Participants ranged from sociologists to political scientists, historians to geographers, urban planners to scholars of media studies. The 3-day conference comprised paper discussions and innovative experimental workshops designed to explore novel research practices. Timon de Groot, Thomas Rohringer, and Marie Schubenz organized the conference "A System Without Anger and Fondness? Bureaucracy and Emotions in Modern Society" in September 2016. Young historians were invited to discuss their use of historical



sources from the archives of bureaucracies. The conference integrated the study of emotions into research on bureaucratic governance in order to complement the analysis of bureaucratic norms and discourses. In addition to the funding that PhD candidates receive for archival expenses and project-related expenses (such as language courses, funding for attending conferences,

etc.), IMPRS PhD candidates are also encouraged to actively apply for third-party funding. PhD students of the IMPRS Moral Economies have been awarded funding from different institutions, such as a research grant from the German Historical Institute in London (Alexandra Esche) or the Eadington Fellowship from the University of Nevada, Las Vegas (Paul Franke).

Table 2. PhD Candidates at the IMPRS Moral Economies

PhD Candidate	Institution	Project Title
Yaara Bengel Alaluf	MPIB	The emotional economy of British seaside holiday-making 1870–1918
Tobias Bernet	FU	Moral economies of urban dwelling: Nonprofit housing in Germany, Austria, and Switzerland (20th/21st century)
Björn Blaß	FU	Environments of disposal: Moralities, practices, and localities of waste (1880–1930)
Anna Borrero	TU	From vermin to hero: Shifting attitudes toward soldiers in US-American society from the Vietnam War to the War on Terror
Sören Brandes	FU	The rise of market populism: The media history of neoliberalism, 1940–1990
Anna Danilina	MPIB	Ethics of essence: On the emotional production of “Aryan” subjectivity in Völkisch settlements, 1890–1925
Timon de Groot	HU	Shame and the search for rehabilitation: Pardoning practices in Germany, 1870–1933
Lena Eggers	FU	Suffering love: The relation between religion and bourgeois experiences of romantic love in late 18th- and early 19th-century Germany
Alexandra Esche	MPIB	Under a cloak of civility: Bourgeois answers to the “Jewish Question” in London and Berlin 1890–1914
Paul Franke	HU	The production of “Monaco” and “Las Vegas” as sites of (un)moral economies
Till Großmann	MPIB	Planned love? Advice communication on marriage and partnership in the GDR
Çiçek İngiz	MPIB	When history goes mad: Rewriting the history of state violence in Dersim
Julia Lieth	MPIB	Between pleasure and immorality: Western allies’ soldiers’ clubs in Germany as sites of encounters between occupiers and the occupied in the 1940s and 1950s
Thomas Lindner	TU	Transnational networks of anti-imperialism: Mexico City in the long 1920s
Marvin Menniken	MPIB	Between conservatism, Cold War, and counterculture: The American Legion in California, 1950–1980
Marius Oesterheld	MPIB	Idleness, industry and self-fulfillment: The ethics and psychology of work in late Imperial and early Republican China
Thomas Rohringer	TU	Spaces and emotional styles: War victims in the interwar period (1920s–1930s)
Britt Schlünz	HU	Healing and holiness: Religious provocateurs during the 19th century
Frederik Schröer	MPIB	Religious tradition—secular ethics? Transformations of Tibetan Buddhist ethics in 20th-century South Asia
Marie Schubenz	MPIB	Contested solidarity: Moral economies in the trade union movement of the 1970s and 1980s
Fabian Steininger	MPIB	Community concepts of Turkish nationalist networks in the late Ottoman Empire
Petru Szedlaczek	TU	Political workings of the ideology of remoteness: Imagining the Szeklerland as a moral site of cultural resistance in the 20th century

## International Max Planck Research School on Computational Methods in Psychiatry and Ageing Research (COMP2PSYCH)



The IMPRS COMP2PSYCH was founded in early 2016 and is affiliated with the Max Planck UCL Centre for Computational Psychiatry and Ageing Research (see pp. 195–200). Like the Centre, the IMPRS COMP2PSYCH is located in both London and Berlin. In addition to the Max Planck Society and University College London (UCL), the Humboldt-Universität zu Berlin is also an institutional partner of the school.

This graduate program is dedicated to training young scientists in computational and statistical methods that help to address the causes of psychiatric disorders as well as the causes of individual differences in cognitive development, with an emphasis on adulthood and old age. The IMPRS COMP2PSYCH aims to equip young researchers with computational and statistical tools that bridge the gap between disease-related molecular and structural changes in the brain that help to identify the ways in which functional and structural changes of the brain are associated to both normal and pathological changes in behavior.

The first cohort of predoctoral fellows was recruited in 2016 and a second is being selected in the spring of 2017. To be eligible, students must have successfully completed an M.A., or equivalent, in a discipline relevant to the school's program, for example, psychology, psychiatry, computer science, applied mathematics, cognitive neuroscience, molecular biology, or genetics. Most of the successful applicants are likely to have some form of background in computer science or applied mathematics, coupled with some

form of documented interest and training in psychology, psychiatry, or cognitive neuroscience.

The 3-year training program involves seminars, methods workshops, participation in summer schools, and collaborative supervision of research training (see Table 1). The main focus of the Berlin site is on cognitive and theoretical neuroscience questions that are relevant to understanding individual development from childhood to old age. Methods include neuroimaging, computational modeling of behavior and brain, and large-scale behavioral and neural data collection. Collaboration across the Berlin and London sites is encouraged.

*Table 1.* The scientific curriculum of the IMPRS COMP2PSYCH consists of four modules to be taught in an integrated fashion

Module 1: Key Research Questions in Psychiatry, Lifespan Psychology, and Decision Science
Module 2: Foundations of Computing
Module 3: Research Design and Data Analysis
Module 4: Empirical Applications of Advanced Computational Methods

### Fellows

*Benjamin Chew*, UCL  
*Julian Q. Kosciessa*,  
MPI for Human  
Development  
*Yunzhe Liu*, UCL

### Berlin Faculty

*Andreas M. Brandmaier*  
*Douglas D. Garrett*  
*Ralph Hertwig*  
*Ulman Lindenberger*  
(Co-Speaker)  
*Thorsten Pachur*  
*Timothy J. Pleskac*  
*Wouter van den Bos*  
*Manuel C. Voelkle*  
*Timo von Oertzen*

### London Faculty

*Peter Dayan*  
*Ray J. Dolan*  
(Co-Speaker)  
*Janaina Mourao-Miranda*  
*Robb Rutledge*

### Coordinator

*Silke Schäfer*  
MPI for Human  
Development





## International Max Planck Research School on Adapting Behavior in a Fundamentally Uncertain World (Uncertainty)

This graduate program is part of the Max Planck Society's framework of International Max Planck Research Schools (IMPRS). It was established in 2007 and, based on an external review process, in 2011 the school was extended for an additional 6 years.

### Spokespersons

*Christoph Engel,*  
MPI for Research on  
Collective Goods

*Oliver Kirchkamp,*  
Friedrich Schiller  
University Jena

### Coordinator

*Susanne Büchner,*  
MPI for Research on  
Collective Goods

The Uncertainty School is jointly hosted by:

- MPI for Research on Collective Goods, Bonn
- MPI for Human Development, Berlin
- MPI of Economics, Jena (until 12/2014)
- Friedrich Schiller University Jena—  
Department of Social Psychology
- Friedrich Schiller University Jena—  
Department of General Psychology
- Friedrich Schiller University Jena—School of  
Economics and Business Administration
- University of Cologne—Faculty of Manage-  
ment, Economics, and Social Sciences
- Indiana University, Bloomington—Program  
in Cognitive Science, and Workshop in  
Political Theory and Policy Analysis
- The Hebrew University of Jerusalem—  
Center for the Study of Rationality
- University of Trento—Interdepartmental  
Centre for Research Training in Economics  
and Management, CIFREM
- University of Bonn—Faculty of Law

The goal of the school is to provide advanced training in doing research on explaining and predicting human decision making under uncertainty and designing institutions that improve this decision making. Research ideas and methods from various disciplines are used, such as psychology, economics, and law.

Students come in with a master's degree (or equivalent) and are awarded a doctoral degree from one of the partner universities or from other universities in Berlin. Besides having access to a thesis advisor, students also take advantage of three annual events:

In the 1-week-long thesis workshop, students present a research project and receive feedback from other students and faculty; in the 4-week-long summer school, the emphasis is on teaching condensed courses on state-of-the-art research areas, by faculty in the partner institutions and guest faculty from leading institutions across the world, as well as the initiation of a research project that

includes students from other institutions; finally, in the 1-week-long topics workshop, there is a mix between research-based lectures, roundtable discussions, and hands-on activities, such as learning a new software for running behavioral experiments. Student participation in the program is ensured through the use of a system of credit for the various activities, courses, and projects. So far, 47 students have completed the program and graduated with a doctorate degree (2014–2016: 19). Currently, 31 students are enrolled.

### Past Events 2014–2016

- 10th Topics Workshop,  
Friedrich Schiller University Jena,  
12.10.–14.10.2016.
- 10th IMPRS Uncertainty Summer School,  
Friedrich Schiller University Jena,  
24.07.–19.08.2016.
- 9th Thesis Workshop,  
Harnack House in Berlin,  
29.02.–04.03.2016.
- 9th IMPRS Uncertainty Topics Workshop,  
Maastricht University,  
28.09.–02.10.2015.
- 9th IMPRS Uncertainty Summer School,  
Friedrich Schiller University Jena,  
26.07.–21.08.2015.
- 8th Thesis Workshop,  
Ringberg Castle,  
03.03.–06.03.2015.
- 8th IMPRS Uncertainty Topics Workshop/  
Cologne Doctoral Workshop on Cognition,  
Coordination, Cooperation, and Competition,  
University of Cologne,  
29.09.–01.10.2014.
- 8th IMPRS Uncertainty Summer School,  
MPI of Economics, Jena,  
13.07.–08.08.2014.
- 7th Thesis Workshop of the  
IMPRS Uncertainty,  
Oppurg Castle,  
10.02.–13.02.2014.

## IMPRS Uncertainty Faculty 2014–2016

### MPI for Human Development, Center for Adaptive Behavior and Cognition

*Gerd Gigerenzer*  
*Konstantinos V. Katsikopoulos*  
*Amit Kothiyal*  
*Wasilios Hariskos*

### MPI of Economics, Strategic Interaction Group (until 12/2014)

*Werner Gueth*  
*Federica Alberti*  
*Anna Conte*  
*Paolo Crosetto*  
*Astrid Gamba*  
*Mitesh Kataria*  
*René Levinsky*  
*Astrid Matthey*  
*Natalia Montinari*  
*Tobias Regner*  
*Michael Trost*  
*Ori Weisel*

### MPI for Research on Collective Goods

*Christoph Engel*  
*Andreas Gloeckner*  
*Niels Petersen*  
*Emmanuel Towfigh*

### University of Cologne, Faculty of Management, Economics and Social Sciences

*Felix Bierbrauer*

### Hebrew University, Center for the Study of Rationality

*Menahem Yaari*  
*Yaakov Kareev*

### Indiana University, Department of Brain and Psychological Sciences

*Peter M. Todd*  
*Jerome Busemeyer*  
*Robert Goldstone*

### Friedrich Schiller University Jena, School of Economics and Business Administration

*Uwe Cantner*  
*Andreas Freytag*  
*Oliver Kirchkamp*  
*Hans-Walter Lorenz*  
*Markus Pasche*

### Friedrich Schiller University Jena, Institute of Psychology

*Thomas Kessler*  
*Peter Noack*  
*Klaus Rothermund*

### University of Bonn, Institute of Commercial and Economic Law

*Daniel Zimmer*

## IMPRS Uncertainty Doctoral Fellows 2014–2016

*Simón Algorta* (Colombia)  
*Pantelis Pipergias Analytis* (Greece), completed  
*Gulnaz Anjum* (Pakistan), completed  
*Daniel Barkoczi* (Hungary), completed  
*Amalia Alvarez Benjumea* (Spain)  
*Nadine Bläser* (Germany)  
*Astrid Buba* (Austria)  
*Konstantin Chatziathanasiou* (Greece)  
*Stojan Davidovic* (Serbien), completed  
*Christiane Ehses-Friedrich* (Germany)  
*Mike Farjam* (Germany), completed  
*Michael Edem Fiagbenu* (Ghana)  
*Lars Freund* (Germany)  
*Minou Ghaffari* (Germany)  
*Andre Grimes* (USA)  
*Slieman Halabi* (Israel)  
*Yoon Hermstrüwer* (France), completed  
*Svenja Hippel* (Germany)  
*Leonard Hoeft* (Germany)  
*Elisa Hofmann* (Germany)  
*Jana Jarecki* (Germany), completed  
*Giorgi Jvarsheishvili* (Georgia)  
*Magdalena Kaczmarek* (Germany), completed  
*Serhiy Kandul* (Ukraine), completed  
*Marco Kleine* (Germany), completed

*Katharina Klement* (Germany)  
*Carlos Kurschilgen* (Spain)  
*Pascal Langenbach* (Germany)  
*Lisa Lenz* (Germany)  
*Laura Lyhs* (Germany), completed  
*Wladislaw Mill* (Germany)  
*Laxmi Natarajan* (India)  
*Olexandr Nikolaychuk* (Ukraine), completed  
*Ayu Okvitawanli* (Indonesia), completed  
*Marian Panganiban* (Philippines), completed  
*Henning Prömpers* (Germany)  
*Rima-Maria Rahal* (Germany)  
*Martin Rosenauer* (Germany)  
*André Schmelzer* (Germany)  
*Alexander Schneeberger* (Germany)  
*Cornelius Schneider* (Germany)  
*Christina Strobel* (Germany)  
*Jolene H. Tan* (Singapore), completed  
*Andra Toader* (Romania), completed  
*Stephan Tontrup* (Germany)  
*Eugenio Verrina* (Italy)  
*Benedikt Werner* (Germany), completed  
*Charley Wu* (Canada)  
*Monika Ziolkowska* (Poland), completed  
*Lilia Zhurakhovska* (Ukraine), completed



## MaxNetAging Research School

The Max Planck International Research Network on Aging (MaxNetAging) was founded in 2004 by the late Paul B. Baltes. The MaxNetAging Research School (MNARS) was launched by MaxNetAging in October 2007 (Director: James W. Vaupel). The program provides funding for doctoral and postdoctoral students. PhD students can obtain funding for up to a maximum of 3 years, postdocs for up to a maximum of 2 years. The MPI for Human Development is involved in this training program along with more than 20 Max Planck Institutes as well as many other international research institutions.

At the beginning of their term, the PhD students and postdocs spend an initial period of 6 months at the MPI for Demographic Research in Rostock. During this time, they spend approximately 6 hours each week in a course program designed to introduce them to various aspects of aging research. Thereafter,

the PhD students and postdocs continue their PhD education and research projects at the Max Planck Institutes they are affiliated with. During this period, the students are invited to multifaceted MaxNetAging workshops attended by MaxNetAging faculty representing many disciplines and institutions.

### MaxNetAging Faculty at the MPI for Human Development

*Jürgen Baumert*  
*Ute Frevert*  
*Wolfgang Gaissmaier* (as of 02/2014: University of Konstanz, Germany)  
*Ralph Hertwig*  
*Sebastian Horn*  
*Ulman Lindenberger*  
*Timothy J. Pleskac*  
*Michaela Riediger*  
*Wouter van den Bos*  
*Markus Werkle-Bergner*

### MNARS Fellows at the MPI for Human Development

*Elisabeth S. Blanke* (PhD student, MNARS 2012–2015)  
*Hanna Bettine Fechner* (PhD student, MNARS 2012–2015)  
*Christina Leuker* (PhD student, MNARS 2015–)  
*Beate E. Mühlroth* (PhD student, MNARS 2016–)  
*Job J. Schepens* (Postdoc, MNARS 2015–2016)  
*John Wong* (PhD student, MNARS 2011–2014)  
*Veronika Zilker* (PhD student, MNARS 2016–)



Figure 1. Cohort of the MaxNetAging Research School 2016.

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# Services at the Institute



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Excellence in science and scholarship requires a solid, efficient, and adaptive infrastructure. Indeed, the dedication, competence, and creativity of the Institute's staff are the bedrock of its success. This photograph shows members of the service units of the Institute and the support staff of the Institute's research centers and groups. The Institute comprises the following service units: the Library and Research Information and Central IT Unit as scientific services; as well as the Administration, Press and Public Relations Department, Technical Services, and Central Services, which include desktop publishing (DTP)

and graphics, reception, chauffeur, mail, and gardening services; and last and by no means least, the Institute's Cafeteria, which caters for the Institute's staff as well as its guests, be they study participants, conference attendees, visitors, or neighbors. In addition, staff members within each of the research centers and groups provide administrative, research, and IT support. The research staff are indebted to all of these colleagues who are major contributors to the productivity of this Institute and to its special atmosphere.

## Library and Research Information Unit

The Library and Research Information Unit of the MPI for Human Development aims to anticipate, determine, and respond to the Institute's needs for information in the areas of education, history, psychology, sociology, and neighboring disciplines. To support the research, teaching, and publishing activities of the Institute's researchers, the Library seeks to provide an environment and facilities conducive to the efficient and independent use and dissemination of information.

The Library services have been further enhanced during the last 3 years, both content-wise and in terms of easy use.

Spring 2014 saw the public launch of Digital Libraries Connected (DLC), an easy-to-use platform and software that helps researchers to manage digitized resources and to present these publicly in a way that meets scientific requirements. DLC, in whose development we have been actively involved, now holds 2,678 volumes, both books and journals.

In 2014, the Library became a member of the Center for Research Libraries (CRL). The CRL is an international consortium of university, college, and independent research libraries and has a stock of about 5 million media for research and teaching. Our membership gives us access to extensive, digitized South Asian literature from the British Library and the Regenstein Library.

To improve accessibility of our collection shelved in closed stacks, the Library has, for some years already, digitized tables of content of newly acquired books and has offered these as PDFs in the online Library Catalog. Since 2014, these PDFs can be searched via a new Index "[TXT] Table of Contents."

Everybody uses Google Scholar—so does the Library: In 2014, all licenses for electronic journals were linked with Google Scholar. All articles in Google Scholar that are covered by our licenses now show a link "Full text@MPIB Library" that will allow researchers to conveniently click through to the full text. This service is available within the IP range of our Institute; the necessary Google Scholar settings are automatically activated.

Libraries strive to serve their users wherever they may be. Thus, at the beginning of 2015, we introduced a new remote access, "EZProxy" to the e-resources that we offer. In contrast to traditional solutions, all that is required is

a browser to allow immediate access to extensive electronic services from home or while on travel. EZProxy works with all operating systems and can also be used with tablets and other mobile devices.

In 2016, two services designed for mobile devices were launched: a Journal App, BrowZine, offering tables of content for over 18,000 journals, and *Selected E-Books*, presenting newly acquired e-books in an appealing format.

2015 and 2016 have also been years of intensive work behind the scenes, ensuring technical interoperability of our library system with other information systems and standards. Thus, in 2015, the migration of several thousand bibliographic data sets pertaining to our Institute's publications to the Max Planck Society's publication repository (PuRe) was completed. Furthermore, in spring 2016, the Library, concurrently with most German research libraries, adopted Resource Description and Access (RDA), an international standard for descriptive cataloging suited for the digital environment in which libraries now operate that replaces the standards heretofore applicable both in Germany and the United States.

The Library offers currently around 223,000 printed volumes, 133 printed journals, over 18,000 e-journals, and approximately 460,000 e-books and other media.

Author consulting (copyright, open access, e-publishing) and database training were increasingly in demand during the period under review. To keep up to date with our users' needs in a digital environment, where usage cannot be seen with the naked eye and standard usage statistics do not provide sufficient insights, the Library carried out an online survey at the end of 2016 to learn more about users' habits and preferences regarding information procurement and processing.

### Head

*Ursula Flitner*

### Academic Librarian

*Nicole Engelhardt*



Lesendes Mädchen by Gustav Adolph Hennig.

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## Central IT Unit

The central facilities of the Central IT Unit support the individual research centers and other service units at the Institute.

### Head

*Wolfgang Assmann*  
(until 02/2016)  
*Sebastian Lau*

For variable services, such as internet/intranet, the website, software, e-mail, etc., central servers with MS Windows, Mac OS X, and Linux operating systems are installed in the Institute. Several powerful servers build a Citrix server farm. They allow the users to run programs (MATLAB, SAS, SPSS, R, etc.) on the server CPUs from their own workstations (Windows or Mac OS) or tablet computers worldwide, from any location, at any time. "Server-based computing" helps to overcome the different workstation constraints, such as CPU power and local storage.

More and more servers and desktops are being virtualized to realize a consolidation concept that will save resources and provide simplified deployment.

The decentralized computing capacity comprises more than 600 personal computers. Apple computers operate with Mac OSX; PCs are operating on Microsoft Windows or a Linux distribution. A wide array of software is available for the desktop systems. In the Storage Area Network (SAN), there is more than 700 TByte storage capacity available to store data. A central backup service is provided for all persistent data.

To provide the necessary security, a Cisco ASA firewall system is installed. Central anti-virus software Sophos—continuously updated via internet—monitors all servers and personal workstations to avoid data loss caused by viruses and malware.

The integration of all desktop computers in the Local Area Network (LAN) provides access to central resources and cluster capacity. Since 2007, desktop systems are directly connected with a maximum speed of 1 Gbit/s. The network backbone has been upgraded to 10+ Gbit/s in 2012.

A wireless LAN is available for users with mobile devices throughout the entire Institute. The German Research Network Association (Deutsches Forschungsnetz [DFN]) provides the Institute's connections to Wide Area Networks (internet, etc.).

The IT Center's services include:

- operating, optimizing, and developing the central server and network equipment;
- updating and mending Windows operating systems on workplace computers;
- centralized printing capacity, including high-speed and color printers;
- integration of workplace computers in the LAN and wireless LAN;
- making national and international connections (Wide Area Network) available;
- Citrix Terminal services;
- internet services;
- data storage and backup strategies;
- preventive security measures;
- management of the central telephone system, including the voice-mail server;
- user support and troubleshooting for workplace computers and notebooks;
- software acquisition.



Storage.

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# Appendix

A black and white photograph of a modern architectural interior. The scene is dominated by large, curved concrete structures. On the right, a staircase with a metal railing leads upwards. The lighting is dramatic, with strong shadows and highlights, emphasizing the textures and forms of the concrete. The word "Appendix" is overlaid in the center in a white, sans-serif font.

## List of Abbreviations

ABC	Center for Adaptive Behavior and Cognition
ARC	Center for Adaptive Rationality
HoE	Center for the History of Emotions
LIP	Center for Lifespan Psychology
Harding Center	Harding Center for Risk Literacy
Max Planck UCL Centre	Max Planck UCL Centre for Computational Psychiatry and Ageing Research
MPRG Affect	Max Planck Research Group "Affect Across the Lifespan"
MPRG Felt Communities	Max Planck Research Group "Felt Communities? Emotions in European Music Performances"
MPRG iSearch	Max Planck Research Group "iSearch—Information Search, Ecological and Active Learning Research with Children"
MPRG Naturalistic	Max Planck Research Group "Naturalistic Social Cognition"
MPRG REaD	Max Planck Research Group "Reading Education and Development" (REaD)
Heisenberg Research Group	Heisenberg Research Group "Socioemotional Development and Health Across the Lifespan"
Otto Hahn Research Group	Otto Hahn Research Group on Associative Memory in Old Age
COMP2PSYCH	International Max Planck Research School on Computational Methods in Psychiatry and Ageing Research
LIFE	International Max Planck Research School on the Life Course
MEMS	International Max Planck Research School for Moral Economies of Modern Societies
MNARS	MaxNetAging Research School
Uncertainty	International Max Planck Research School on Adapting Behavior in a Fundamentally Uncertain World

Last update: Spring 2017

## 1. Honors and Awards 2014–2016

- Artinger, Florian** Best Paper Award, Academy of Management, 2016.
- Ausbildungsverbund Fachinformatik Berlin—afib** Trainee Prize for outstanding proficiency in vocational education, Max Planck Society, 2016.
- Brandmaier, Andreas M.** The Heinz Billing Award for the Advancement of Computational Science, Heinz Billing Foundation, 2015.
- Brod, Garvin** Otto Hahn Medal 2016, Max Planck Society, 2017.
- Dallacker, Mattea / Hertwig, Ralph / Mata, Jutta** Poster Award, European Health Psychology Society Conference, Aberdeen, UK, 2016.
- Donauer, Sabine** Otto Hahn Medal 2014, Max Planck Society, 2015; German Thesis Award, Körber Foundation, 2014.
- Frevert, Ute** Elected Chairperson of the Scientific Council, Max Planck Society, 2014; The Order of Merit of the Federal Republic of Germany, 2016.
- Frey, Renato** Vontobel Award for Research on Age(ing) (2nd prize), Vontobel Foundation, 2015.
- Gerlach, Philipp** Best Student Poster Award, International Conference on Social Dilemmas, Hong Kong, 2015.
- Gigerenzer, Gerd** Distinguished Scholar Award in Information and Knowledge Science, GIKA, 2014; SAGE Fellow, University of California, Santa Barbara, 2014; Patten Lecturer, Indiana University, 2014; Hufeland Award from the German Foundation for General Medicine (Stiftung Allgemeinmedizin) for improving knowledge and transparency in medicine, 2015; "Risk Savvy: How to Make Good Decisions" shortlisted for the Better Life Award, National Multiple Sclerosis Society, 2015; International Member, American Philosophical Society, 2016; Foreign Honorary Member, American Academy of Arts and Sciences, 2016; Rothschild Distinguished Visiting Professor, Isaac Newton Institute, Cambridge University, 2016; Cognition as Intuitive Statistics (1987, with David J. Murray) re-issued in Psychology Revivals, honoring the most influential scholars of the last 120 years.
- Hertwig, Ralph** Honorary Professor of Psychology, Freie Universität Berlin, 2016; Gottfried Wilhelm Leibniz Prize 2017, German Research Foundation, 2016.
- Hilbrand, Sonja / Coall, David A. / Gerstorff, Denis / Hertwig, Ralph** January 2017 Elsevier Atlas Award for the paper „Caregiving within and beyond the family is associated with lower mortality for the caregiver: A prospective study,“ published in *Evolution and Human Behavior*, Elsevier, 2017.
- Hitzer, Bettina** Walter de Gruyter Prize, Berlin-Brandenburg Academy of Sciences and Humanities (BBAW), 2016.
- Horn, Andreas** Thiemann Fellowship, Thiemann Stiftung, 2015.
- Jenny, Mirjam A.** Otto Hahn Medal 2013, Max Planck Society, 2014.
- Jensen, Uffa** Heisenberg Professorship at the Center for Research on Antisemitism, Technische Universität Berlin, German Research Foundation, 2016.
- Kause, Astrid / McDowell, Michelle** Best Student Award, Society for Risk Analysis—Europe, August 2015.
- Kühn, Simone** Early Career Research Fellowship 2016–2018, Jacobs Foundation, 2015; Heisenberg Professorship at University Medical Center Hamburg–Eppendorf, German Research Foundation, 2016; ERC Starting Grant, European Research Council, 2016.
- Kulkarni, Kedar A.** Distinguished Researcher, Bharat Natya Mandir, Pune, 2014.
- Kvam, Peter D.** Graduate Research Opportunities Worldwide Program, National Science Foundation, 2016.
- Lindenberger, Ulman** Elected Member, Academia Europaea, 2014; Fernand Braudel Senior Fellowship 2015/2016, European University Institute, Fiesole, Italy, 2015; Appointment to the Board of Trustees of the German Thesis Award (Deutscher Studienpreis), Körber Foundation, 2015; Jury Member for the C. L. de Carvalho–Heineken Prize for Cognitive Science 2016–2020, Alfred Heineken Fondsen Foundation, 2015.
- Lorenz, Robert C.** Human Brain Mapping Editor’s Choice Award 2015, Organization for Human Brain Mapping, 2016.
- Mayer, Karl Ulrich** Ehrensenator, University of Tübingen, 2015; Fernand Braudel Senior Fellowship 2017, European University Institute, Fiesole, Italy, 2016.
- Moussaïd, Mehdi** Jane Beattie Scientific Recognition Award, European Association for Decision Making, 2017.
- Pleskac, Timothy J.** Jane Beattie Scientific Recognition Award, European Association for Decision Making, 2015.
- PR Unit** idw Award for Science Communication 2013 (2nd prize), idw scientific information service, 2014.
- Rajamani, Imke** Otto Hahn Medal 2016, Max Planck Society, 2017.
- Ruggeri, Azzurra** Best Early Career Developmental Paper, AIP—Italian Psychological Society, 2014.
- van den Bos, Wouter** APS Rising Star, American Psychological Association, 2015; Early Career Award on the Science of Learning of the FLUX Society, Jacobs Foundation, 2016; Spotlight Poster at Society for Neuroeconomics Conference, Berlin, Germany, 2016.
- Wegwarth, Odette / Gigerenzer, Gerd** Dr. Lothar Beyer Prize 2016 (3rd place) together with colleagues from the Philipps-Universität Marburg, the Charité Universitätsmedizin Berlin, & the University of Konstanz, German Society for General Practice and Family Medicine (DEGAM), 2016.
- Wenger, Elisabeth** Otto Hahn Medal 2014, Max Planck Society, 2015.
- Werkle–Bergner, Markus** Early Career Research Fellowship 2017–2019, Jacobs Foundation, 2016.
- Wulff, Dirk U.** Otto Hahn Medal 2015, Max Planck Society, 2016.

## Grants and Stipends

- Baumert, Jürgen / Maaz, Kai / Köller, Olaf** Funding for Project "BERLIN-Studie: Evaluation des neuen Übergangsverfahrens in Berlin," Senatsverwaltung für Bildung, Jugend und Familie, Berlin, 07/2011–11/2016.
- Bonah, Christian / Laukötter, Anja** (Co-Director) ERC Advanced Grant, "The healthy self as body capital: Individuals, market-based societies and body politics in visual twentieth century Europe," European Research Council, 10/2016–09/2021.
- Brauer, Juliane** Intensive Training „Fast Track: Excellence and leadership skills for outstanding women in science," Robert Bosch Stiftung, 10/2014–05/2016.
- Brehmer, Yvonne** Funding for Project "Associative memory in old age: Mechanisms of inter-individual differences," Karolinska Institutets Forskningsstiftelser, 2014–2015; Research Grant, "Enhanced strategy training in older adults," Stiftelsen för Gamla Tjänarinnor, 2016.
- Brod, Garvin** DAAD Stipend for Research Stay at Stanford University, German Academic Exchange Service, 11/2014–02/2015.
- Eilers, Sarah** Stipend, "COST Action Short Scientific Mission," COST Association, University of Turku, 09–10/2016.
- Esche, Alexandra** Grant, Stiftung Zeitlehren, 08/2016; Stipend for Research Stay at German Historical Institute London, German Historical Institute London, 10–12/2016.
- Filevich, Elisa** FreiGeist-Fellowship, "Metacognition of action: Behavioural and brain bases," Volkswagen Stiftung/Humboldt-Universität zu Berlin, 01/2017–12/2021.
- Garrett, Douglas D.** Emmy Noether Programme, "Toward a structural and functional basis for changes in brain signal variability with age," German Research Foundation, 12/2016–11/2021.
- Garrett, Douglas D. / Westlye, Lars** DAAD-Norway Research Foundation Collaborative Grant, "Clinical utility and genetics of neuronal intra-individual variability in severe mental illness: A Norwegian-German collaboration," German Academic Exchange Service, 01/2016–12/2017.
- Gigerenzer, Gerd** Funding of the Harding Center, Winton Capital Management & Claudia and David Harding Foundation, 2007–; Funding for Project „AOK Faktenboxen," Allgemeine Ortskrankenkasse (AOK), 10/2014–01/2016.
- Gigerenzer, Gerd / Gaissmaier, Wolfgang / Wegwarth, Odette** Funding for Project "Förderung guter medizinischer Entscheidungen," Bertelsmann Stiftung, 04/2013–12/2016.
- Gigerenzer, Gerd / Hertwig, Ralph** Funding for "Summer Institute on Bounded Rationality," Joachim Herz Stiftung, 2014, 2015, 2016.
- Gigerenzer, Gerd / Jenny, Mirjam A.** Funding for Project „Förderung der Gesundheitskompetenz," Helsana Health Insurance, 03/2016–03/2017; Funding for Project „Faktenboxen," VIACTIV Krankenkasse, 05–09/2016.
- Gigerenzer, Gerd / Rebitschek, Felix G. / Jenny, Mirjam A.** Funding for Project "Webbasierter, evidenzbasierter Risikooltas—Werkzeuge zur nachhaltigen Stärkung der Risikokompetenz (WebPRA)," Federal Ministry of Justice and Consumer Protection (BMJV), 07/2016–12/2019.
- Hertwig, Ralph / Hills, Thomas** Funding for Project "Search in space and minds: Dynamics in structure in recall from long-term memory search," Swiss National Science Foundation, 04/2010–12/2014.
- Hertwig, Ralph / Pachur, Thorsten** Funding for Project "Algebraic models of heuristics of risky choice: Irreconcilable foes or useful allies?" as part of the DFG Priority Program "New frameworks of rationality," German Research Foundation, 04/2012–03/2015; Funding for Project "How efficient are choice heuristics under varying degrees of uncertainty?" as part of the DFG Priority Program "New frameworks of rationality," German Research Foundation, 04/2015–03/2018.
- Hertwig, Ralph / Rieskamp, Jörg / De Quervain, Dominique / Papassotiropoulos, Andreas** Funding for Project "Biological foundations of risk taking," Swiss National Foundation, 06/2012–02/2016.
- Herzog, Stefan M. / Hertwig, Ralph** Funding for Project "Dialectical bootstrapping: A new paradigm to improve individual judgment," Swiss National Science Foundation, 01/2010–02/2017.
- Jenny, Mirjam A.** Membership in the Young Leaders in Science program, Ernst Schering Foundation, 05/2016–04/2017.
- Jensen, Uffa** Heisenberg Professorship at the Center for Research on Antisemitism, Technische Universität Berlin, German Research Foundation, 2016.
- Katsikopoulos, Konstantinos V. / Gruene-Yanoff, Till / Keller, Niklas** Organization of Workshop "Nudge versus educate: Comparing two approaches to policy in terms of their modeling strategies," Wissenschaftskolleg zu Berlin, 06/2014.
- Kounine, Laura** Early Career International Research Fellow, ARC Centre of Excellence for the History of Emotions, University of Melbourne, 2014.
- Kühn, Simone** Heisenberg Professorship at University Medical Center Hamburg-Eppendorf, German Research Foundation, 02/2017–02/2020; ERC Starting Grant, "Take control! Towards novel training regimes enhancing inhibition and impulse control in health and psychiatric disease," European Research Council, 08/2016–08/2021.
- Kurvers, Ralf H. J. M.** DFG Fellowship, "The role of individual differences in collective behaviour," in cooperation with Leibniz-Institute of Freshwater Ecology and Inland Fisheries, German Research Foundation, 07/2016–07/2019.
- Lee, Joel / Bellamy, Carla / Falahi, Masood Alam / Kaur, Manpreet** International Collaborative Research Grant, "Contesting untouchability in Islam: The religious history of Dalit Muslims in India," American Academy of Religion & International Association for the History of Religions, 04/2014–01/2015.

- Lindenberger, Ulman** Funding for Project "Hippocampal subfield volumes in normal human cognitive aging: Individual variation and plasticity," Strategic Innovation Fund of the Max Planck Society, 01/2014–12/2016; Funding for Project "Probing and enhancing plasticity of auditory cortex in human adults: Investigating functional and structural changes following pitch discrimination training, Strategic Innovation Fund of the Max Planck Society, 06/2015–05/2018.
- Lindenberger, Ulman** / Dolan, Raymond J. Collaborative Research Project "MPS-UCL Initiative on Computational Psychiatry and Ageing Research," Max Planck Society & University College London, 04/2011–03/2014; Max Planck UCL Centre for Computational Psychiatry and Ageing Research in cooperation with University College London & Humboldt-Universität zu Berlin, Max Planck Society, 04/2014–03/2019.
- Lindenberger, Ulman** / Düzel, Emrah / Sendtner, Michael / Kreutz, Michael Collaborative Research Project "Energizing the hippocampus in aging individuals (EnerGI)," in cooperation with the German Center for Neurodegenerative Diseases (DZNE), Universitätsklinikum Würzburg, & Leibniz Institute for Neurobiology, Federal Ministry of Education and Research (BMBF), 07/2015–06/2020.
- Lindenberger, Ulman** / Steinhagen-Thiessen, Elisabeth / **Wagner, Gert G.** Collaborative Research Project "Berlin Aging Study II," in cooperation with Geriatrics Research Group of the Charité Universitätsmedizin Berlin, Socio-Economic Panel at the German Institute for Economic Research, & Max Planck Institute for Molecular Genetics, Federal Ministry of Education and Research (BMBF), 12/2011–05/2015.
- Marewski, Julian N.** / **Gigerenzer, Gerd** / **Schooler, Lael J.** Funding for Project "Strategy selection," Swiss National Science Foundation, 04/2013–03/2016.
- Meder, Björn** / **Nelson, Jonathan D.** / **Martignon, Laura** / Crupi, Vincenzo / Tentori, Katya Funding for Project "Models of information search: A theoretical and empirical synthesis," as part of the DFG Priority Program "New frameworks on rationality," German Research Foundation, 12/2014–11/2017.
- Möller, Jens / **Baumert, Jürgen** / Köller, Olaf Funding for Project "EUROPA-Studie: Bilingualer Unterricht in den Staatlichen Europa-Schulen in Berlin—ein praktikabler Weg, die Bildungsbenachteiligung von Zuwandererkindern zu reduzieren?," Stiftung Mercator & Senatsverwaltung für Bildung, Jugend und Familie, Berlin, 11/2013–11/2016.
- Nelson, Jonathan D.** / **Meder, Björn** / **Martignon, Laura** / Crupi, Vincenzo / Tentori, Katya Funding for Project "Models of information search: A theoretical and empirical synthesis," as part of the DFG Priority Program "New frameworks on rationality," German Research Foundation, 10/2014–10/2017.
- Olsen, Stephanie** Insight Development Grant, "Raising hope in the First World War: Educating children and youth in Britain, Canada, New Zealand and Australia," in cooperation with McGill University, Social Science and Humanities Research Council of Canada, 06/2014–05/2017.
- Prinz, Roman** / **Gigerenzer Gerd** Funding for Project "VISUAL—Systematische Verwertung wirtschaftswissenschaftlicher Evidenz durch Visualisierung und Problemlösung," in cooperation with Fraunhofer Center for International Management and Knowledge Economy, German Aerospace Center (DLR), 04/2016–03/2018.
- Riediger, Michaela** Heisenberg Stipend, German Research Foundation, 06/2015–05/2018.
- Riediger, Michaela** / Bajbouj, Malek Research Grant, "On the interplay of endocrine functioning and socio-emotional competencies from adolescence to old age: Implications for emotion," in cooperation with Charité Universitätsmedizin Berlin & Freie Universität Berlin, Focus Area DynAge, 01–12/2016.
- Ruggeri, Azzurra** Marie Curie International Outgoing Fellowship, University of California, Berkeley, USA, European Commission, 12/2013–11/2016.
- Schepens, Job J.** Marie Skłodowska-Curie Individual Fellowship, "Neurocomputational mechanisms underlying age-related performance changes in goal-directed decisions from experience (AGERISK)," European Commission, 09/2016–03/2019.
- Schroeder, Sascha** Funding for Project "Transfereffekte musikalischer Frühförderung auf Kognition und Lesentwicklung (MusiCo)," Rat für Kulturelle Bildung, 01/2014–12/2017.
- Schroeder, Sascha** / Grainger, Jonathan Funding for Project „The role of morphemes during reading development," German Research Foundation & ANR—The French National Research Agency, 03/2016–02/2018.
- Schroeder, Sascha** / Richter, Dirk / Böhme, Katrin Funding for Project "Effects of reading instruction on cognitive processing (ERIC)," German Ministry for Education and Research (BMBF), 07/2015–06/2017.
- Shing, Yee Lee** / Heim, Christine Funding for Project "Delineating the contribution of glucocorticoid pathways to stress-related social disparities in cognitive child development," Jacobs Foundation, 01/2015–07/2018.
- Şimşek, Özgür** Funding for Project "Rationality of heuristics in a changing environment," as part of the DFG Priority Program "New Frameworks of rationality," German Research Foundation, 10/2011–09/2014.
- Ulbrich, Uwe / **Hertwig, Ralph** / Voss, Martin / Gerhold, Lars Funding for Project "WEXICOM—Weather warnings: from EXtreme event Information to COMmunication and action," within the Hans-Ertel-Centre for Weather Research (HERZ) in cooperation with Deutscher Wetterdienst (DWD) & Freie Universität Berlin, funded by DWD, 03/2015–02/2018.
- van den Bos, Wouter** / van Duijvenvoorde, Anna / Vidding, Essi Open Research Area Grant for Project „Adaptive social learning in typical and atypical developing adolescents," German Research Foundation & The Netherlands Organization for Scientific Research & Economic and Social Research Council, 06/2016–06/2019.
- Voelkle, Manuel C.** / Beauducel, Andre / Klein, Christoph Funding for Project "Development of intraindividual variability of processing speed," German Research Foundation, 10/2012–12/2016.
- Wagner, Gert G.** / Rapael, Lutz Funding for Workshops "Archiv sozial- und wirtschaftswissenschaftlicher Erhebungen," Werner Reimers Stiftung, 12/2016–.
- Wagner, Gert G.** / **Riediger, Michaela** / **Voelkle, Manuel C.** Funding for Project "Affektive Flexibilität im Lebensverlauf," German Research Foundation, 03/2016–02/2018.

- Wegwarth, Odette** European Union's Horizon 2020 Research and Innovation Project, "Female cancer prediction using cervical omics to individualise screening and prevention (FORECEE)," in cooperation amongst others with University College London, Erasmus Medical Center Rotterdam, & Karolinska Institutet, European Commission, 09/2015–08/2018.
- Wenger, Elisabeth** Membership in Sign-Up! Career building program for female postdocs, Max Planck Society, 2016.
- Werkle–Bergner, Markus / Shing, Yee Lee** Funding for Project "Hippocampal subfield contributions to memory formation: Child developmental trends and interaction with top–down control during adulthood," German Research Foundation, 10/2014–08/2017.
- Wiegand, Iris** Marie Skłodowska–Curie Individual Global Fellowship, "Attention and memory components in everyday cognitive problems in aging (MEMORAGE)," in cooperation with Brigham and Women's Hospital & Harvard Medical School–Harvard University, European Commission, 03/2017–03/2020.

## Professorship Offers

(labeled in accordance with American system)

- Brick, Timothy R.** Assistant Professor of Human Development and Family Studies, The Pennsylvania State University, 2014 (accepted).
- Brighton, Henry** Assistant Professor of Cognitive Science and Artificial Intelligence, Tilburg University, Netherlands, 2016 (accepted).
- Cabanas, Edgar** Associate Professor of Psychology, University of Barcelona, Spain, 2016 (accepted); Associate Professor of Psychology, Universitat Oberta de Catalunya, Spain, 2016 (accepted); Associate Professor of Psychology, Camilo José Cela University, Madrid, Spain, 2016 (accepted).
- Ellerbrock, Dagmar** Full Professor of Modern and Contemporary History, Technische Universität Dresden, 2014 (accepted).
- Galesic, Mirta** Associate Professor of Human Social Dynamics, Santa Fe Institute, USA, 2014 (accepted).
- Garcia, Luis–Manuel** Assistant Professor of Popular Music, University of Groningen, Netherlands, 2014 (accepted).
- Katsikopoulos, Konstantinos V.** Associate Professor of Behavioral Operations, University of Southampton, UK, 2016 (accepted).
- Kounine, Laura** Assistant Professor of History, University of Sussex, UK, 2016 (accepted).
- Kühn, Simone** Full Professor of Neural Plasticity in Psychiatric Disease, University Medical Center Hamburg–Eppendorf, Germany, 2016 (accepted).
- Lee, Joel** Assistant Professor of Anthropology, Williams College, Williamstown, MA, USA, 2015 (accepted).
- Lejarraga, Thomás** Associate Professor of Economics, University of the Balearic Islands, Palma, Spain, 2016 (accepted).
- Luong, Gloria** Assistant Professor of Human Development and Family Studies, Colorado State University, Fort Collins, CO, USA, 2015 (accepted).
- Mata, Jutta** Assistant Professor of Health Psychology, University of Basel, Switzerland, 2014 (accepted); Full Professor of Health Psychology, University of Mannheim, Germany, 2014 (accepted).
- Mata, Rui** Assistant Professor of Psychology, University of Basel, Switzerland, 2014 (accepted).
- Nielsen, Philipp** Assistant Professor of History, Sarah Lawrence College, Bronxville, NY, USA, 2015 (accepted).
- Ostwald, Dirk** Assistant Professor of Computational Cognitive Neuroscience, Freie Universität Berlin, Germany, 2014 (accepted).
- Riediger, Michaela** Full Professor of Developmental Psychology, Friedrich Schiller University Jena, Germany, 2016 (accepted).
- Schaefer, Sabine** Assistant Professor of Exercise Psychology, Leipzig University, Germany, 2014 (accepted); Associate Professor of Movement Science, Saarland University, Germany, 2015 (accepted).
- Shing, Yee Lee** Full Professor of Developmental Psychology, Goethe University Frankfurt am Main, Germany, 2017 (offered).
- van den Bos, Wouter** Assistant Professor of Psychology, University of Amsterdam, Netherlands, 2016 (offered).
- Voelkle, Manuel C.** Full Professor of Psychological Research Methods, Humboldt–Universität zu Berlin, Germany, 2014 (accepted); Full Professor of Psychological Research Methods, Ulm University, 2014 (declined); Associate Professor of Psychological Research Methods, University of Bremen, Germany, 2014 (declined); Associate Professor of Psychological Research Methods, Freie Universität Berlin, Germany, 2014 (declined).

## 2. Research Colloquia 2014–2016

### **Abraham, David**

University of Miami, USA  
The German circumcision controversy:  
Immigration, religion, history, and science  
08.12.2015

### **Abramczuk, Katarzyna**

University of Warsaw, Poland  
In web we trust: Pitfalls and solutions  
30.09.2014

### **Abramson, Paul R.**

University of California, Los Angeles, USA  
Condoms suck: Navigating the risks and realities  
of safer sex  
19.01.2016

### **Adolph, Karen**

New York University, USA  
Learning to move  
01.07.2014

### **Anokhin, Andrey**

Washington University in St. Louis, USA  
Impulsivity: Genetic and developmental  
perspectives  
21.06.2016

### **Assaf, Yaniv**

Tel Aviv University, Israel  
The CONNECTOME: Structure, function,  
and evolution  
17.11.2015

### **Bahrami, Bahador**

University College London, UK  
Metacognitive fingerprints: A model-based  
approach to individual differences in decision  
confidence  
18.02.2016

### **Bailey, Richard**

International Council of Sport Science and Physical  
Education, Berlin, Germany  
Educational and exercise neuroscience: The good,  
the bad, and the ugly  
05.11.2014

### **Barra, Mícheál de**

Stockholm University, Sweden  
How feedback biases give ineffective medicine a  
good reputation  
25.02.2014

### **Barrett, H. Clark**

University of California, Los Angeles, USA  
Towards an evolutionary psychological phenomics:  
Mapping human cognitive architecture using cross-  
cultural comparisons  
09.09.2015

### **Bauer, Susanne**

Berlin University of the Arts (UdK), Germany  
Musik im Spannungsfeld zwischen (der Suche nach)  
Autonomie und (dem Wunsch nach) Zugehörigkeit  
03.07.2014

### **Bavelier, Daphne**

University of Geneva, Switzerland  
Action video games as exemplary learning tools  
17.06.2014

### **Beilock, Sian**

University of Chicago, USA  
Academic performance under stress: At the inter-  
section of emotion and cognitive control  
09.10.2015

### **Bentivegna, Eloisa**

Wissenswerkstatt Berlin, Germany  
Comparing exhaustive, intuitive, and metaheuristic  
strategies in mastermind games  
19.03.2014

### **Bertola, Mauro**

Heidelberg University, Germany  
Das zerrissene Band: Musik, Nation und Tradition im  
italienischen Musikdiskurs, 1890–1945  
29.01.2015

### **Betsch, Tilman**

University of Erfurt, Germany  
Treasure hunters and mousekids: Some lessons to be  
learned from child decision making  
12.02.2015

### **Bhatia, Sudepp**

University of Warwick, UK  
A model of associative judgment  
16.04.2015

### **Bialystok, Ellen**

York University, Toronto, Canada  
Bilingualism as a form of neuroplasticity:  
Consequences for mind and brain  
08.03.2016

### **Bifone, Angelo**

Istituto Italiano di Tecnologia (IIT), Rovereto, Italy  
A translational approach to brain functional con-  
nectivity in neuropsychiatric disorders  
09.11.2016

### **Boehling, Rebecca**

University of Maryland, Baltimore, USA  
Fate clarification and the need for "closure" across  
generations: Family members' search for informa-  
tion about the path of persecution of victims of  
nazism  
11.10.2016

### **Boker, Steven M.**

University of Virginia, Charlottesville, USA  
Adaptive equilibrium regulation: A model for the  
dynamics of plasticity  
03.08.2016

### **Bound Alberti, Fay**

Queen Mary University of London, UK  
From face off to the face race: The death of  
Isabelle Dinoire and the emotional history of face  
transplants  
01.11.2016

### **Bramley, Neil**

University College London, UK  
Connecting and pruning—Exploring heuristics for  
interventional causal learning across environments  
28.05.2014

### **Brockmann, Dirk**

Humboldt-Universität zu Berlin, Germany  
Have we been looking at global disease dynamics all  
wrong? The hidden geometry of complex, network-  
driven contagion phenomena  
19.11.2014

### **Brown, Gordon**

University of Warwick, UK  
Social norms and polarisation: A cognitive model  
01.07.2015

- Brown, Timothy**  
Northeastern University, Boston, USA  
Environmentalism and the politics of consciousness in Germany, 1968–1989  
25.10.2016
- Bunge, Silvia**  
University of California, Berkeley, USA  
Eye tracking as a window into typical and atypical brain development  
30.09.2015
- Busemeyer, Jerome**  
Indiana University, Bloomington, USA  
Can quantum probability theory provide a new foundation for understanding human judgment and decision making?  
31.03.2015
- Butler Schofield, Katherine**  
King's College London, UK  
Music, art and affective power between North India and the Deccan  
19.05.2015
- Camilleri, Adrian**  
Royal Melbourne Institute of Technology, Australia  
The format of online review score information influences consumer choices—A role for attribution  
31.10.2016
- Cassel, Justine**  
Carnegie Mellon University, Pittsburgh, USA  
Promises and perils of educational technology  
12.08.2016
- Chapman, Gretchen**  
Rutgers University, New Brunswick, USA  
Judge, nudge, dodge: Doing what's good for us  
16.03.2016
- Charness, Gary**  
University of California, Santa Barbara, USA  
Creativity and incentives  
15.12.2014
- Cokely, Edward**  
Michigan Technological University, Houghton, USA  
What does it mean to understand risk and why is numeracy such a strong predictor of risk literacy?  
26.05.2015
- Colzato, Lorenza**  
Leiden University, Netherlands  
Enhancing brain and cognition  
06.08.2014
- Cosgrove, Mary**  
University of Warwick, UK  
Memory and melancholy in postwar German literature  
06.05.2014
- Cottier, Maurice**  
University of Bern, Switzerland  
Interpersonal violence, emotions, and modern subjectivity: The example of Bern, Switzerland 1868–1941  
15.11.2016
- Daum, Moritz**  
University of Zurich, Switzerland  
Interrelations between action and language in development  
09.02.2016
- Dayan, Peter**  
University College London, UK  
Heuristics of control: Habitization, fragmentation, memoization, and pruning  
13.10.2015
- Deco, Gustavo**  
University Pompeu Fabra, Barcelona, Spain  
Towards a global model of brain activity: Lessons from the human connectome  
23.09.2015
- Dennerlein, Christoph**  
University of Göttingen, Germany  
Emotionen in der Musikästhetik um 1900  
09.01.2014
- Denz, Stefanie**  
Humboldt-Universität zu Berlin, Germany  
Jazz als musikalischer Vermittler von Kulturtransfer im Exil am Beispiel von Chris McGregor und The Blue Notes  
22.01.2015
- Dimov, Cvetomir**  
University of Lausanne, Switzerland  
Predicting behavioural and neural responses during decision making within a cognitive architecture  
09.02.2016
- Duden, Barbara**  
Gottfried Wilhelm Leibniz Universität Hannover, Germany  
Somatische Gefühle—gefühlte Somatik: Anregungen aus der Körpergeschichte  
20.05.2014
- Dugan, Niels**  
Wairarapa Hospital, Masterton, New Zealand  
A fast and frugal tree applied to medical decision making  
11.11.2015
- Durbach, Ian**  
University of Cape Town, South Africa  
Prescriptive decision analysis and fast-and-frugal heuristics: Points of convergence, divergence, and opportunity  
02.09.2015
- Ebner, Natalie**  
University of Florida, Gainesville, USA  
Processing social-emotional information in aging: A neuro-behavioral analysis  
02.06.2014
- Elsner, Birgit**  
University of Potsdam, Germany  
From goals to intentions: The emerging understanding of others' actions in early childhood  
11.11.2015
- Epstein, Robert**  
American Institute for Behavioral Research and Technology, Vista, USA  
The search engine manipulation effect (SEME): Search rankings can shift voter preferences substantially without their awareness  
18.03.2015
- Fei, Siyen**  
University of Pennsylvania, Philadelphia, USA  
Encountering the barbaric others: Emotive narrative of sinicization and de-sinicization in 16th-century China  
02.06.2015

- Feltz, Adam**  
Michigan Technological University, Houghton, USA  
Transparency v. persuasion in risk communication  
16.09.2014
- Fiske, Alan P.**  
University of California, Los Angeles, USA  
Knowing and telling how to relate: Heuristics for social coordination  
03.07.2014
- Föcker, Julia**  
University of Geneva, Switzerland  
The multiple facets of brain plasticity: How sensory deprivation and video game experience shape neural networks  
09.04.2014
- Forth, Christopher E.**  
The University of Kansas, Lawrence, USA  
Compulsion and the emotions  
13.10.2015
- Fox, Craig**  
University of California, Los Angeles, USA  
Two dimensions of subjective uncertainty  
28.10.2016
- Frank, Stephanie Mathilde**  
Humboldt-Universität zu Berlin, Germany  
Emotionalisierte öffentliche Diskussionen und der "entspannte" Heimatfilm? Das Wechselverhältnis von Debatten um Jugend und Musik und die Inszenierungen des populären Genre-Kinos der 1950er-Jahre  
15.01.2015
- Frankenhuis, Willem E.**  
Radboud University Nijmegen, Netherlands  
Cognitive adaptation to harsh environments  
23.06.2016
- Funder, David**  
University of California, Riverside, USA  
The fundamental attribution error revisited: Implications for integration  
12.03.2014
- Geisthövel, Alexa**  
Humboldt-Universität zu Berlin, Germany  
Martin Kippenberger hört Whitney Houston: Über das Verhältnis von Musik, Subkultur und Dissidenz am Beispiel Punk  
22.05.2014
- Gerstenberg, Tobias**  
Massachusetts Institute of Technology, Cambridge, USA  
A counterfactual simulation model of causal judgement  
03.09.2014
- Goebel, Eckart**  
New York University, USA  
Ritter zwischen Tod und Teufel: Thomas Mann—Freud—Faustus  
15.04.2014
- Gredebäck, Gustaf**  
Uppsala University, Sweden  
Social cognition and motor development in infancy  
05.05.2015
- Grossmann, Atina**  
The Cooper Union, New York City, USA  
Too emotional? Or queering the genres? Mixing family and straight history  
28.10.2014
- Grüne-Yanoff, Till**  
KTH Royal Institute of Technology, Stockholm, Sweden  
Does transparency deteriorate default effects?  
18.06.2015
- Guercini, Simone**  
University of Florence, Italy  
Adoption and scope of heuristics rules in business networks  
24.09.2014
- Güntürkün, Onur**  
Ruhr-Universität Bochum, Germany  
The parallel evolution of cognition  
24.02.2015
- Hagemann, Karen**  
University of North Carolina, Chapel Hill, USA  
Memory and emotions: The anti-Napoleonic wars in 19th-century historical novels  
05.05.2015
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Birkbeck, University of London, UK  
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- Haikka, Pinja**  
Aarhus University, Denmark  
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11.07.2016
- Halperin, David**  
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- Hamm, Robert**  
The University of Oklahoma, USA  
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- Harden, K. Paige**  
The University of Texas at Austin, USA  
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14.07.2015
- Hastie, Reid**  
University of Chicago, USA  
The answer to the riddle of induction  
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University of Chicago, USA  
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01.10.2014
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University of California, Irvine, USA  
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12.08.2016
- Henson, Richard**  
University of Cambridge, UK  
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24.09.2015
- Hodgkinson, Gerard**  
University of Warwick, UK  
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25.02.2015
- Hofer, Matthias**  
University of Vienna, Austria  
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05.05.2015
- Hommel, Bernhard**  
Leiden University, Netherlands  
Cognitive representation of action and self  
30.07.2014
- Hotelling, Jared**  
University of Basel, Switzerland  
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26.05.2015
- House, Bailey**  
MPI for Evolutionary Anthropology, Leipzig, Germany  
Moral normativity and the emergence of cooperation in middle childhood  
30.07.2015
- Hoven, Lena van der**  
Humboldt-Universität zu Berlin, Germany  
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University of Amsterdam, Netherlands  
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University of Tübingen, Germany  
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14.07.2015
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Princeton University, USA  
Unpacking the black box of causality: Learning about causal mechanisms from experimental and observational studies  
28.04.2015
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University of Southern California, Los Angeles, USA  
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01.12.2015
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Johns Hopkins University, Baltimore, USA  
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University of Miami, USA  
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04.02.2014
- Joslyn, Susan**  
University of Washington, Seattle, USA  
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25.08.2016
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10.05.2016
- Kaiser, Konstantin**  
planpolitik, Berlin, Germany  
Teaching politics with an interactive, online-collaboration game  
12.05.2015
- Karlawish, Jason**  
University of Pennsylvania, Philadelphia, USA  
The house of Alzheimer's disease  
19.04.2016
- Kesteren, Marlieke van**  
Vrije Universiteit Amsterdam, Netherlands  
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15.12.2015
- Keys, Barbara Jean**  
The University of Melbourne, Australia  
Diplomatic love affair: Henry Kissinger and Zhou Enlai  
26.04.2016
- Kievit, Rogier**  
University of Cambridge, UK  
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11.02.2014
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An overview of the work of the Behavioural Insights Team  
25.09.2014
- Kivimäki, Ville**  
University of Tampere, Finland  
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23.06.2015
- Kliegel, Matthias**  
University of Geneva, Switzerland  
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25.02.2014
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Aarhus University, Denmark  
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05.11.2015
- Koellinger, Peter**  
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21.01.2016
- Kolesch, Doris**  
Freie Universität Berlin, Germany  
Stimme, Resonanz und Affektivität  
26.06.2014
- Körner, Axel**  
University College London, UK  
Moderne auf der Bühne leben: Verdis Amerika und gesellschaftlicher Umbruch in Italien zur Zeit der Einigung  
30.10.2014

- Koskuba, Karla**  
University College London, UK  
It's your fault we lost: How children assign reward/punishment when winning/losing a team game  
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- Kostopoulou, Olga**  
Imperial College London, UK  
Supporting physicians' first diagnostic impressions  
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- Krueger, Joachim**  
Brown University, Providence, USA  
Egocentrism in the volunteer's dilemma  
12.04.2016
- Krüger, Antonio**  
Saarland University, Saarbrücken, Germany  
Adaptive digital ecosystems: The role of human behaviour measurement in intelligent system design  
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University of Erfurt, Germany  
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Harvard University, Cambridge, USA  
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03.02.2015
- Kurzban, Robert**  
University of Pennsylvania, Philadelphia, USA  
Why everyone (else) is a hypocrite: Evolution and the modular mind  
09.04.2015
- Kvam, Peter D.**  
Michigan State University, East Lansing, USA  
Computational models of cognitive dissonance effects  
26.02.2015
- Kyriakoudis, Louis**  
Middle Tennessee State University, Murfreesboro, USA  
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20.01.2016
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University of Passau, Germany  
Corruption and the diffusion of responsibility  
19.03.2015
- Le Mens, Gael**  
Universitat Pompeu Fabra, Barcelona, Spain  
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17.06.2015
- Lee, Alejandro**  
The University of Nottingham, UK  
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01.09.2015
- Lee, Jennifer**  
University of California, Irvine, USA  
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01.04.2016
- Leese, Peter**  
University of Copenhagen, Denmark  
Historical trauma studies: A new agenda  
12.01.2015
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Technische Universität Dresden, Germany  
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05.02.2015
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Erasmus University, Rotterdam, Netherlands  
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22.04.2014
- Liu, Taosheng**  
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10.09.2015
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University of Warwick, UK  
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- Manzini, Paola**  
University of St. Andrews, Edinburgh, UK  
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06.05.2015
- Maß, Sandra**  
Georg Eckart Institute for International Textbook Research, Braunschweig, Germany  
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University of California, Davis, USA  
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09.12.2014
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University of Oregon, Eugene, USA  
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06.06.2014
- McClure, Samuel**  
Stanford University, USA  
Using fMRI to inform psychological theories of delay discounting  
07.07.2014
- McCrudden, Christopher / King, Jeff**  
Wissenschaftskolleg zu Berlin, Germany / University College London, UK  
Choice architecture, educational tools and framing of information  
14.02.2015
- McElreath, Richard**  
MPI for Evolutionary Anthropology, Leipzig, Germany  
A new research program on human adaptation in ecological context  
04.10.2016
- McNamara, John**  
University of Bristol, UK  
Ecological rationality and environmental complexity  
15.09.2015
- Menon, Vinod**  
Stanford University School of Medicine, USA  
Typical and atypical development of brain networks: Implications for behavior and cognition  
06.12.2016
- Meier, Rita**  
RWE AG, Essen, Germany  
Risk management at RWE  
21.02.2015

- Meyer-Sickendick, Burkhard**  
Freie Universität Berlin, Germany  
Zärtlichkeit: Zu den aristokratischen Quellen der bürgerlichen Empfindsamkeit  
01.07.2014
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New York University Abu Dhabi, UAE  
Emotionologies and perceptions of political space in the German popular media, ca. 1800  
21.06.2016
- Mitchell, Lisa**  
University of Pennsylvania, Philadelphia, USA  
Staging the political: Public space and emotion in the history of Indian democracy  
11.11.2014
- Monk, Chris**  
Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany  
Exploration versus exploitation in a natural resource environment: How do fishermen balance personal versus social information in deciding where to fish?  
02.07.2015
- Montibeller, Gilberto**  
University of Loughborough, UK  
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25.05.2016
- Moormann, Peter**  
University of Cologne, Germany  
"Dem Enthusiasmus eine Richtung geben"—Gustavo Dudamel und seine Klangkörper  
12.02.2015
- Morat, Daniel**  
Freie Universität Berlin, Germany  
Brausende Hochrufe, leuchtende Augen, ein Überschwang, von dem die Herzen überfließen: Akustische Mobilisierung und kollektive Affekte am Beginn des Ersten Weltkriegs  
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Freie Universität Berlin, Germany  
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- Mosoreanu, Marius**  
Babes-Bolyai University, Klausenburg, Romania  
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- Mousavi, Shabnam**  
Johns Hopkins University, Baltimore, USA  
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02.09.2014
- Mueser, Peter**  
University of Missouri, Columbia, USA  
The endowment effect: Can ownership play a role in rational decision making?  
04.12.2014
- Mullett, Timothy**  
University of Warwick, UK  
How attention biases choice: Looking equals choosing, but looking doesn't equal weighting  
10.11.2015
- Musholt, Kristina**  
Otto von Guericke University Magdeburg, Germany  
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25.06.2014
- Newell, Ben**  
University of New South Wales, Sydney, Australia  
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05.03.2015
- Nußbruch, Simon**  
University of Würzburg, Germany  
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Heidelberg University, Germany  
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- Olds, Justin**  
University of Lausanne, Switzerland  
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- Orquin, Jacob Lund**  
Aarhus University, Denmark  
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22.10.2014
- Osman, Magda**  
Queen Mary University of London, UK  
The value of effort  
29.04.2015
- Otis, Laura**  
Emory University, Atlanta, USA  
Revealing metaphors for banned emotions  
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- Otte, Marline**  
Tulane University, New Orleans, USA  
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- Pattersen, Karen**  
University of Pennsylvania, Philadelphia, USA  
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Institut du Cerveau et de la Moelle épinière (ICM), Paris, France  
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University of Cape Town, South Africa  
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University of Michigan, Ann Arbor, USA  
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German Sport University Cologne, Germany  
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University of Lausanne, Switzerland  
The Punk scenes: Places of conflicting emotions. Dissent, fun, community or scandal: What is the meaning of style after all?  
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- Reid, Andrew T.**  
Radboud University Nijmegen, Netherlands  
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- Rosa, Hartmut**  
Friedrich Schiller University Jena, Germany  
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Ghent University, Belgium  
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- Rostom, May**  
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- Rothrock, Ling**  
The Pennsylvania State University, USA  
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- Roy, Srirupa**  
University of Göttingen, Germany  
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- Rugg, Michael**  
The University of Texas at Dallas, USA  
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- Sakaki, Michiko**  
University of Reading, UK  
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- Scaglia, Ilaria**  
Columbus State University, USA  
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- Schaper, Ulrike**  
Freie Universität Berlin, Germany  
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- Schley, Dan**  
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Fifty shades of "medium": The psychology of intermediate attribute levels  
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University of Pennsylvania, Philadelphia, USA  
Decision aids for screening use: Is it ethically sufficient to ensure availability, or are incentives called for?  
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University College London, UK  
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Technische Universität München (TUM), Germany  
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- Seyd, Benjamin C.**  
Friedrich Schiller University Jena, Germany  
Die affektive Signatur der Globalisierung: Zur gefühlsmäßigen Verfassung der globalen Moderne und ihren Perspektiven  
24.05.2016

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University of California, Berkeley, USA  
The martyr and the heretic: The suspicious Christianity of the sixteenth century  
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- Slezkine, Yuri**  
University of California, Berkeley, USA  
The House of Government in Moscow  
21.01.2014
- Stanley, Jeffrey A.**  
Wayne State University, Detroit, USA  
Specificity of altered hippocampal modulation of glutamate to memory encoding in schizophrenia: A preliminary 1H-fMRS study  
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Vanderbilt University, Nashville, USA  
The normals: A shadow history of human experiment  
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Brown University, Providence, USA  
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University of Warwick, UK  
Expected utility, unexpected results  
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- Sugden, Robert**  
University of East Anglia, Norwich, UK  
Preference purification and the inner rational agent: A critique of the conventional wisdom of behavioural welfare economics  
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Yale School of Management, New Haven, USA  
Risky curves  
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- Sunstein, Cass**  
Harvard University, Cambridge, USA  
The ethics of nudging  
29.06.2015
- Suny, Ronald**  
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Explaining the Armenian genocide: Strategic choices within the disposition of Ottoman perpetrators  
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- Sutter, Matthias**  
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Aarhus University, Denmark  
"Teeth broken everywhere": Space, violence and new emotional repertoires in Copenhagen around 1900  
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- Tirosh, Yofi**  
Tel Aviv University, Israel  
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Indiana University, Bloomington, USA  
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- Toelch, Ulf**  
Freie Universität Berlin, Germany  
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- Tornow, Harald**  
e/|/s-Institut GmbH für Qualitätsentwicklung sozialer Dienstleistungen, Wülfrath, Germany  
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- Troop, Paul**  
Garden Court Chambers, London, UK  
Legal norms are primarily for improving the transparency of judicial behaviour (not influencing the behaviour of the population-at-large)  
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- Tucker-Drob, Elliot**  
The University of Texas at Austin, USA  
Gene-environment interplay in lifespan cognitive development  
08.07.2015
- Turkheimer, Erik**  
University of Virginia, Charlottesville, USA  
Gene-environment correlations as the driver of behavioral diversity  
15.10.2014
- Ullén, Frederik**  
Karolinska Institutet, Stockholm, Sweden  
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01.11.2016
- Usborne, Cornelia**  
University of Roehampton, London, UK  
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22.06.2016
- Van De Ville, Dimitri**  
University of Geneva, Switzerland  
Restless at rest: Dynamic functional connectivity to probe spontaneous network organisation  
13.05.2014
- Van Delden, Hans**  
UMC Utrecht, Netherlands  
Revision of the CIOMS ethical guidelines for biomedical research  
27.01.2016
- van Rooij, Iris**  
Radboud University Nijmegen, Netherlands  
Rational analysis, intractability and the prospects of "as if" explanations  
27.03.2014
- van Rooij, Tibor**  
University of Alberta, Canada  
Fast and frugal decision trees: Combining information technology and genetic data to improve medical decision making in developing countries  
10.07.2014

- Viswanath, Rupa**  
University of Göttingen, Germany  
The performance of solace: Violence and representation in postcolonial South India  
07.07.2015
- Volkov, Shulamit**  
Tel Aviv University, Israel  
Searching the boundaries of humanity:  
Deaf and dumb at the Age of Enlightenment  
30.06.2015
- von Dolder, Dennie**  
The University of Nottingham, UK  
Judgment and decision making in casinos and lotteries: Wisdom of crowds and number preferences  
04.02.2016
- von Oertzen, Timo**  
University of Virginia, Charlottesville, USA  
Urban legends in psychological methods  
28.01.2014
- von Scheve, Christian**  
Freie Universität Berlin, Germany  
Affektive Relationalität in Formen des sozialen Miteinanders  
16.02.2016
- von Xylander, Cheryce**  
Technische Universität Darmstadt, Germany  
Probing the politics of nostalgia  
14.10.2014
- Wakker, Peter**  
Erasmus University Rotterdam, Netherlands  
Measuring ambiguity attitudes for all (natural) events  
11.02.2016
- Waldmann, Michael**  
University of Göttingen, Germany  
Transfers effects between moral dilemmas: A causal model theory  
08.10.2015
- Wallsten, Thomas S.**  
University of Maryland, College Park, USA  
Galton meets Goldberg: Subjective forecasting of continuous variables (especially as applied to the occurrence of geopolitical events)  
15.10.2014
- Wareheim, Todd / Otworowska, Maria**  
Memorial University of Newfoundland, St. Johns, Canada  
When can the adaptive toolbox be adaptive?  
A computational analysis  
26.06.2015
- Weber, Julia**  
Freie Universität Berlin, Germany  
Architekturen der Seele: Ein Reiseführer in literarische Innenwelten  
04.02.2014
- Weber, Martin**  
University of Mannheim, Germany  
How much to invest into risk? Can we do the trade-off between risk and return?  
09.01.2014
- Weiskopf, Nikolaus**  
MPI for Human Cognitive and Brain Sciences, Leipzig, Germany  
Toward in-vivo histology using magnetic resonance imaging (MRI)  
29.09.2015
- Wheeler, Gregory**  
Ludwig-Maximilians-Universität München (LMU Munich), Germany  
If it works for one, what about for two? Group decision making  
20.10.2016
- Whitaker, Robert**  
Science and medical writer, Cambridge, USA  
Anatomy of a global epidemic: History, science and the long-term effects of psychiatric medications  
21.10.2014
- Whitman, Jennifer**  
The University of British Columbia, Vancouver, Canada  
Functionally connected brain networks underlying probabilistic reasoning  
27.10.2014
- Wicherts, Jelte**  
Tilburg University, Netherlands  
Human factors in the analysis of psychological data and reporting of results  
09.07.2015
- Widaman, Keith**  
University of California, Riverside, USA  
Indices of environmental and genetic cumulative risk: Construct validity requirements, implications for hypothesis testing  
30.06.2015
- Wilke, Andreas**  
Clarkson University, Potsdam, USA  
Heuristics in biology  
25.11.2015
- Wirsching, Andreas**  
Ludwig-Maximilians-Universität München (LMU Munich), Germany  
Enttäuschung als Grundstimmung der Geschichte des 20. Jahrhunderts  
07.06.2016
- Wittekind, Charlotte**  
University Medical Center Hamburg-Eppendorf, Germany  
Information processing of disorder-specific stimuli in psychological disorders—Basic research and intervention  
16.02.2015
- Wolf, Richard**  
Harvard University, Cambridge, USA  
Love and its malcontents: Emotional discourse in "The Voice in the Drum"  
12.05.2015
- Woods, Marjorie**  
The University of Texas at Austin, USA  
Classical emotions in the medieval classroom  
18.11.2014
- Wöstmann, Malte**  
MPI for Human Cognitive and Brain Sciences, Leipzig, Germany  
Neural dynamics of understanding speech in noise: Effects of task demands, age, and hearing loss  
08.12.2014

### 3. Conferences, Workshops, and Seminars 2014–2016

#### **Building Computational Models of Cognitive Processes**

ABC and ARC workshop

04.02.2014

#### **Was heißt Heterogenität—und wie antwortet die Schule?**

CER information event about the EUROPA-Study, jointly organized with the Institute of Psychology at Kiel University & the Leibniz Institute for Science and Mathematics Education at Kiel University

26.02.2014

#### **All a Question of Age? How the Brain and Behaviors Develop Over Time**

Max Planck UCL Centre panel discussion in cooperation with Max Planck Society

09.04.2014

#### **Introductory Workshop**

LIFE workshop

10.04.–14.04.2014

#### **Adaptive Rationality**

LIFE seminar (weekly sessions)

April–July 2014

#### **Sounds—Klänge—Töne: Zur klanglichen Dimension von Musik und ihrer emotionalen Bedeutung und Wahrnehmung**

MPRG Felt Communities conference

24.04.–26.04.2014

#### **LIFE Spring Academy 2014**

International academy

27.04.–02.05.2014

#### **Missing Data: Introduction to the Analysis of Incomplete Data Sets**

LIFE workshop in cooperation with Michigan State University

14.05.2014

#### **Blankensee—Colloquium Nudge Versus Educate: Comparing Two Approaches to Policy in Terms of Their Modeling Strategies**

ABC colloquium, jointly organized with Charité Universitätsmedizin Berlin, KTH Royal Institute of Technology in Stockholm, & Wissenschaftskolleg zu Berlin

03.06.–06.06.2014

#### **Data Analysis Beyond p-Values: A Practical Introduction to Bayesian Statistics**

LIFE workshop in cooperation with ARC

03.06.2014

#### **Simple Solutions for a Complex World**

13th Summer Institute on Bounded Rationality, hosted by ABC and ARC, funded by Joachim Herz Stiftung

10.06.–17.06.2014

#### **Longitudinal Imaging Plus**

LIP workshop Berlin-Zurich, jointly organized with University of Zurich

12.06.–13.06.2014

#### **Memory and Temporalities**

HoE workshop

18.06.2014

#### **Feeling for the Community**

HoE workshop, jointly organized with Centre d'Études de l'Inde et de l'Asie du Sud (CEIAS, Paris)

27.06.–28.06.2014

#### **Comparing Civil Gun Cultures: Do Emotions Make the Difference?**

HoE international conference

26.08.–28.08.2014

#### **2nd Max Planck UCL Symposium and Advanced Course in Computational Psychiatry and Ageing Research**

Max Planck UCL Centre symposium

07.09.–13.09.2014

#### **LIFE Presentation Training**

LIFE workshop

16.09. and 25.11.2014

#### **Concepts, Language and Beyond: Emotions and Values**

HoE Summer School

22.09.–27.09.2014

#### **LIFE Fall Academy 2014**

International academy

09.10.–13.10.2014

#### **R-Tutorial**

LIFE workshop (five sessions)

October–November 2014

**Methods in Research on Human Development**

LIFE seminar (weekly sessions)  
October 2014 – February 2015

**Global Concepts**

HoE seminar  
01.11.2014

**Academic Writing**

LIFE workshop  
13.11. and 20.11.2014

**LIFE Presentation Training**

LIFE workshop  
25.11.2014

**Choice Architecture, Educational Tools, and Framing of Information**

ABC workshop and discussion  
04.02.2015

**Voxel-Based-Morphometry (VBM) Workshop**

LIP workshop  
18.02.2015

**Sexotic: Workshop on Moral Economies, Body Techniques, Media, and the Interplay Between Sexuality and Exotization**

HoE workshop, jointly organized with Freie Universität Berlin  
19.02.–20.02.2015

**The Cognition, Brain, and Aging (COBRA) Project**

LIP meeting in cooperation with Umeå University & Karolinska Institutet  
23.02.–24.02.2015

**FSL Course**

LIP workshop  
18.03.–20.03.2015

**NYLON Graduate Student Conference**

13th annual conference, hosted by MEMS and HoE  
20.03.–22.03.2015

**Social Change, Cohort Inequalities, and Life Courses in Germany—Historical and Cross-National Perspectives**

Symposium and a Reception on the Occasion of the 70th Birthday of Karl Ulrich Mayer  
10.04.2015

**EPROC Meeting 2015**

Annual meeting of the European Group of Process Tracing Studies, hosted by ARC and ABC  
16.04.–18.04.2015

**Education Across the Lifespan**

LIFE seminar (weekly sessions)  
April–July 2015

**Introductory Workshop**

LIFE seminar  
14.04.–16.04.2015

**LIFE Spring Academy 2015**

International academy  
18.05.–22.05.2015

**Criminal Law and Emotions in European Legal Cultures: From 16th Century to the Present**

HoE conference  
21.05.–22.05.2015

**Simply Rational: 20 Years of ABC Research**

ABC conference  
01.06.–03.06.2015

**Homo Heuristics in the Economy**

14th Summer Institute on Bounded Rationality, hosted by ABC and ARC, funded by Joachim Herz Stiftung  
04.06.–11.06.2015

**Long Night of the Sciences**

Public event  
13.06.2015

**Monsoon Feelings**

HoE conference  
25.06.–27.06.2015

**LifeBrain Workshop**

LIP workshop in cooperation with University of Oslo & Umeå University  
02.07.–03.07.2015

**Emotionsgeschichte und Musik: Forschungsperspektiven und Methoden**

MPRG Felt Communities conference  
18.09.–19.09.2015

- LIFE Presentation Training**  
LIFE workshop (four sessions)  
October–November 2015
- Philosophy of Science**  
LIFE seminar (weekly sessions)  
October 2015 – February 2016
- LIFE Fall Academy 2015**  
International academy  
18.10.–22.10.2015
- EU-COST Action EREAD Workgroup Meeting**  
MPRG REaD workshop  
14.03.–17.04.2016
- Fellows' Project Presentations**  
LIFE seminar (weekly sessions)  
April–July 2016
- Alternative Careers**  
LIFE workshop  
28.04.2016
- EUROPA-Studie: Was leistet die Staatliche Europa-Schule Berlin?**  
CER symposium, jointly organized with the Institute of Psychology at Kiel University & the Leibniz Institute for Science and Mathematics Education at Kiel University  
29.04.2016
- Common Room—Architecture, Democracy and Emotions Since 1945**  
HoE conference  
25.05.–27.05.2016
- LIFE Spring Academy 2016**  
International academy  
29.05.–02.06.2016
- Witchcraft and Emotions: Social Conflict and the Judicial Process**  
HoE conference, jointly organized with The University of Melbourne & The University of Western Australia & Barrett Honors College at Arizona State University  
23.06.–24.06.2016
- Better Decisions in a Complex World**  
15th Summer Institute on Bounded Rationality, hosted by ABC and ARC, funded by Joachim Herz Stiftung  
27.06.–05.07.2016
- Promoting Understanding of Statistics About Society**  
Roundtable conference of the International Association for Statistical Education (IASE), hosted by ABC  
19.07.–22.07.2016
- Academic Writing**  
LIFE workshop  
25.08. and 01.09.2016
- Introductory Workshop**  
LIFE workshop  
07.09.–09.09.2016
- 3rd Max Planck UCL Symposium and Advanced Course on Computational Psychiatry and Ageing Research**  
Max Planck UCL Centre symposium  
11.09.–17.09.2016
- A System Without Anger and Fondness? Emotions in the Age of Bureaucracy**  
HoE conference  
15.09.–16.09.2016
- Developmental Theory and Methodology of the Lifespan**  
LIFE seminar (weekly sessions)  
October 2016 – January 2017
- COGITO Conference**  
LIP conference, jointly organized with Humboldt-Universität zu Berlin, Karolinska Institutet, & German Institute for International Educational Research (DIPF)  
04.10.–06.10.2016
- LIFE Fall Academy 2016**  
International academy  
06.10.–10.10.2016
- Risikoatlas**  
Scientific kick-off workshop, hosted by Harding Center for Risk Literacy  
08.12.–09.12.2016
- Failing at Feelings: Historical Perspectives (1800–2000)**  
HoE conference  
15.12.–16.12.2016

## 4. Visiting Researchers 2014–2016

- Amano, Mayu**  
The University of Nottingham, UK  
August–October 2016
- Appel, Giselle**  
Columbia University, New York, USA  
January 2016; May–July 2016
- Avarahami, Judith**  
The Hebrew University of Jerusalem, Israel  
October–November 2015
- Aydogan, Ilke**  
Erasmus University Rotterdam, Netherlands  
May–June 2016
- Bautista, Randy**  
University of Southern California, Los Angeles, USA  
June–August 2014
- Beacock, Ian Patrick**  
Stanford University, USA  
July–September 2015
- Berg, Nathan**  
University of Otago, Dunedin, New Zealand  
February–March 2015
- Boddice, Rob**  
Freie Universität Berlin, Germany  
January 2014 – February 2016
- Bodemer, Nicolai**  
University of California, Berkeley, USA  
November 2014 – September 2017
- Boiger, Michael**  
University of Leuven (KU Leuven), Belgium  
October 2013 – December 2014
- Boker, Steven M.**  
University of Virginia, Charlottesville, USA  
May–June 2014; July 2015; August 2016
- Brick, Timothy R.**  
The Pennsylvania State University, USA  
June–July 2015
- Brotos, Fanny H.**  
Spanish National Research Council (CSIC),  
Madrid, Spain  
September 2014 – December 2015
- Brower, Eleanor**  
Indiana University, Bloomington, USA  
May–July 2015
- Brown, Gordon**  
University of Warwick, UK  
June–July 2015
- Bunge, Silvia**  
University of California, Berkeley, USA  
September 2015; October 2016
- Coenen, Anna**  
New York University, USA  
June–September 2015
- Colzato, Lorenza**  
Leiden University, Netherlands  
July–August 2014
- Constantinescu, Michaela**  
University of Bucharest, Romania  
April–May 2015
- DeKay, Michael**  
Ohio State University, Columbus, USA  
August 2014 – July 2015
- Do, Young Kyung**  
Seoul National University College of Medicine,  
South Korea  
September 2016 – August 2017
- Dugan, Niels**  
Wairarapa Hospital, Masterton, USA  
August–November 2015
- Ewing, Christopher**  
The City University of New York, USA  
June–August 2016
- Fischer, Sven**  
Max Planck Institute of Economics, Jena, Germany  
February–December 2015
- Flückiger, Lavinia**  
University of Basel, Switzerland  
October 2013 – May 2014
- Greenhalgh, Charlotte**  
Monash University, Melbourne, Australia  
June–July 2015
- Grüne-Yanoff, Till**  
KTH Royal Institute of Technology,  
Stockholm, Sweden  
June 2014; June 2015
- Gummerum, Michaela**  
Plymouth University, UK  
July–August 2015; August–September 2016
- Hahn, Ulrike**  
University of London, UK  
June–July 2014
- Haksöz, Çağrı**  
Sabancı University School of Management,  
Istanbul, Turkey  
February–August 2015
- Hanoach, Yaniv**  
Plymouth University, UK  
August 2014
- Hastie, Reid**  
University of Chicago, USA  
October 2014
- Hein, Benjamin Peter**  
Stanford University, USA  
October–December 2014
- Hertzog, Christopher**  
Georgia Institute of Technology, Atlanta, USA  
May–June 2014; June 2015
- Hidano, Noboru**  
Tokyo Institute of Technology, Japan  
September–October 2015
- Hintze, Arend**  
Michigan State University, East Lansing, USA  
July 2014
- Hommel, Bernhard**  
Leiden University, Netherlands  
July–August 2014
- Ito, Takashi**  
Tokyo University of Foreign Studies, Japan  
July–August 2015
- Jakoby, Nina**  
University of Zurich, Switzerland  
January 2014
- Janett, Mirjam Lynn**  
University of Basel, Switzerland  
November 2016 – July 2017
- Kareev, Yaakow**  
The Hebrew University of Jerusalem, Israel  
October–November 2015
- Keys, Barbara Jean**  
The University of Melbourne, Australia  
April–May 2016

- Khader, Patrick H.**  
Ludwig-Maximilians-Universität München  
(LMU Munich), Germany  
July–August 2014; March 2015;  
October 2015 – April 2016
- Kheirandish, Reza**  
Clayton State University, Morrow, USA  
June–August 2015; May 2016 – January 2017
- Kivimäki, Ville**  
University of Tampere, Finland  
February–June 2015
- König, Laura**  
Plymouth University, UK  
February–December 2015
- Kozyreva, Anastasia**  
Heidelberg University, Germany  
June 2016 – June 2017
- Krueger, Joachim I.**  
Brown University, Providence, USA  
July 2015; March–April 2016
- Kvam, Peter D.**  
Michigan State University, East Lansing, USA  
September 2014 – August 2017
- Liu, Taosheng**  
Michigan State University, East Lansing, USA  
August–October 2015
- Liu, Yongfang**  
East China Normal University, Shanghai, China  
July–September 2014; August–September 2016
- Mather, Mara**  
University of Southern California, Los Angeles, USA  
September 2014 – July 2015; June–August 2016
- Maurer, Cornelius**  
École normale supérieure, Paris, France  
April 2016 – March 2017
- Mayr, Ulrich**  
University of Oregon, Eugene, USA  
June 2014; March 2015; July 2015; October 2016
- Meier, Rita**  
RWE AG, Essen, Germany  
January–December 2015
- Minsky, Amir**  
New York University Abu Dhabi, UAE  
May–July 2016
- Montgomery, Jennifer**  
Binghamton University – State University of New  
York, USA  
September 2016 – June 2017
- Newell, Ben**  
University of New South Wales, Sydney, Australia  
March–June 2015
- Olsson, Henrik**  
University of Warwick, UK  
August 2012 – January 2014
- Orquin, Jacob Lund**  
Aarhus University, Denmark  
February 2014 – December 2015
- Otis, Laura**  
Emory University, Atlanta, USA  
September 2014 – August 2015
- Öztop, Pinar**  
Plymouth University, UK  
August 2015 – December 2016
- Pearman, Ann**  
Georgia Institute of Technology, Atlanta, USA  
May–June 2014
- Petersen, Malte**  
FernUniversität in Hagen, Germany  
January 2014 – September 2017
- Pitman, Sophie**  
University of Cambridge, UK  
September 2016 – August 2017
- Polk, Thad**  
University of Michigan, Ann Arbor, USA  
August 2014; July–August 2015; June–July 2016
- Pöyhönen, Samuli**  
University of Helsinki, Finland  
July 2016 – July 2017
- Raboud, Pierre**  
University of Lausanne, Switzerland  
March–September 2015
- Scaglia, Ilaria**  
Columbus State University, USA  
September 2016 – June 2017
- Schoop, Margret Aenne**  
Jacobs University Bremen, Germany  
May 2016
- Schulz, Eric**  
University College London, UK  
June–July 2014; July 2016
- Schürmann, Oliver**  
University of Basel, Switzerland  
May–October 2015
- Seltenreich, Yair**  
Tel Aviv University, Israel  
September–October 2016
- Stoica, Gabriela**  
University of Bucharest, Romania  
April–May 2015
- Toro Blanco, Pablo Andrés**  
Alberto Hurtado University, Santiago, Chile  
June 2015
- Troop, Paul**  
University College London, UK  
October–November 2015
- Undurraga, Veronica**  
Pontificia Universidad Católica de Chile,  
Santiago, Chile  
June–July 2016
- Vanunu, Yonatan**  
Tel Aviv University, Israel  
June–September 2016
- Vejlby, Anna Schram**  
University of Copenhagen, Denmark  
November 2014 – January 2015
- Wagner, Stefan J.**  
King's College London, UK  
February–May 2015
- Waldmann, Michael**  
University of Göttingen, Germany  
September–October 2015
- Wallsten, Thomas S.**  
University of Maryland, College Park, USA  
October 2014
- Wilke, Andreas**  
Clarkson University, Potsdam, USA  
October 2015 – January 2016
- Wrzus, Cornelia**  
Johannes Gutenberg University Mainz, Germany  
October 2013 – December 2014
- Yanacek, Holly**  
University of Pittsburgh, USA  
September 2014 – July 2015
- Zhou, Lei**  
Beijing Normal University, China  
October 2015 – September 2016

## 5. Other Professional Activities 2014–2016

- Assmann, Wolfgang** – Ausbildungsverband Fachinformatik Berlin–afib (Coordinator), 2005–2016
- Baumert, Jürgen**
- Association of Berlin Merchants and Industrialists (VBKI): "Bürger Netzwerk Bildung" (Advisory Board)
  - Berlin Senate Administration for Education, Youth, and Science: Teacher Education Committee (Chair)
  - CARINA Stiftung (Board of Trustees), 2008–2014
  - Center for International Educational Comparison Studies (ZIB), Technische Universität München (Board of Trustees), 2010–2014
  - Department of Educational Sciences, Universität Hamburg (Chair of the Evaluation Committee), 2016–
  - European Research Council (ERC) (Panel Member for the 2017 Consolidator Grant call), 2016–
  - Federal Ministry for Education and Research (BMBF), "House of Little Scientists" Initiative for Preschool Children (Board of Trustees)
  - Institute for Educational Quality Improvement (IQB), Humboldt-Universität zu Berlin (Governing Board), 2004–2014
  - Journal "Psychologie in Erziehung und Unterricht" (Advisory Board)
  - Journal "Schweizerische Zeitschrift für Bildungswissenschaften" (Advisory Board)
  - Journal "Zeitschrift für Erziehungswissenschaft" (Co-Editor)
  - Journal "Zeitschrift für Unterrichtswissenschaft" (Co-Editor), 1991–2014
  - Knowledge Media Research Centre, Tübingen (Board of Trustees), 2010–2014
  - LEAD (Learning, Educational Achievement, and Life Course Development), Graduate School & Research Network, Tübingen (Advisory Board), 2015–
  - "Lebenswelt Schule"—A joint program of the German Children and Youth Foundation and the Jacobs Foundation (Advisory Board)
  - Programme for the International Assessment of Adult Competencies (PIAAC) (Advisory Board)
  - Ruhr-Universität Bochum, Professional School of Education (Advisory Board)
  - Society for Empirical Educational Research (GEBF) (Vice President), 2012–2014
  - Steering Committee of the Joint Commission of the German Federal and Länder Governments on Monitoring the Performance of the German Education System in accordance with Art. 91b (2) of the German Basic Law (Chair of the Advisory Board), 2007–2014
  - Waxmann Verlag's series on educational psychology and developmental psychology (Advisory Board)
- Bednarek–Gilland, Antje** – Journal "Miscellanea Anthropologica et Sociologica" (Co-Editor)
- Beljan, Magdalena**
- Dahlem International Network Junior Research Group "Art Couples: Relationship Dynamics and Gender Relations in the Arts" (Freie Universität Berlin/MPI for Human Development), 2014–
  - Journal "Body Politics: Zeitschrift für Körpergeschichte" (Co-Editor)
- Bender, Andrew R.** – Hippocampal Subfields Group, Boundaries Working Group (Contributing Member)
- Brighton, Henry** – Journal "Frontiers in Cognitive Science" (Associate Editor)
- Cabanas, Edgar** – Journal "Philosophy Study" (Editorial Board Member), 2016
- Czienskowski, Uwe** – Ethics Committee of the MPI for Human Development (Member), 2015–
- Cohrdes, Caroline**
- Jahrbuch Musikpsychologie (Consulting Editor), 2015–
  - Journal "Musicae Scientiae" (Consulting Editor), 2015–
- Düzel, Sandra**
- Equal Opportunities Representative of the MPI for Human Development, 2012–2016
  - Journal "Frontiers in Psychology: Cognition" (Review Editor), 2015–

- Edelstein, Wolfgang**
- Buddy e.V. (Advisory Board)
  - Deutsche Gesellschaft für Demokratiepädagogik (German Association for Democratic Education) (Member)
  - Institut für angewandte Familien-, Kindheits- und Jugendforschung e.V., Potsdam (Scientific Advisory Board)
  - International Journal of Developmental Science (Editorial Board)
- Eitler, Pascal**
- Journal "Body Politics: Zeitschrift für Körpergeschichte" (Chief Editor)
- Ellerbrock, Dagmar**
- Verband Historiker und Historikerinnen Deutschlands (Board Member), 2012–2014
- Elsner, Claudia**
- Ethics Committee of the MPI for Human Development (Member), 2016–
- Fandakova, Jana**
- Ethics Committee of the MPI for Human Development (Member), 2016–
- Filevich, Elisa**
- Journal "Frontiers in Psychology" (Associate Editor), 2014–2015
- Fleischhut, Nadine**
- Ethics Committee of the MPI for Human Development (Member), 2015–
- Frevert, Ute**
- Alexander von Humboldt Foundation, Berlin (International Advisory Board), 2009–2015
  - American Academy in Berlin (Selection Committee)
  - Berlin-Brandenburg Academy of Sciences and Humanities (Member)
  - British Academy for the Humanities and Social Sciences, London (Corresponding Fellow)
  - Centre Marc Bloch, Berlin (Advisory Board), 2012–2014
  - Deutsche Bahn Foundation, "Bildung und Kultur" (Education and Culture) (Board of Trustees)
  - Einstein Forum, Potsdam (Advisory Board)
  - European Research Council (Panel Member)
  - Foundation Deutsches Hygiene Museum, Dresden (Board of Trustees)
  - German Academy of Sciences Leopoldina (Member)
  - German Historical Institute, Washington DC (Advisory Board)
  - German-Israeli Foundation for Scientific Research and Development (GIF) (Member)
  - Geschichte und Gesellschaft—Journal of Historical Social Sciences (Co-Editor/Managing Director)
  - Historical Journal, Cambridge University Press (Advisory Board)
  - Humboldt-Viadrina School of Governance, Berlin (Board of Trustees)
  - Institute for Human Sciences, Vienna (Advisory Board)
  - International Max Planck Research School for Moral Economies of Modern Societies (Principal Investigator and Spokesperson)
  - Journal "Body Politics: Zeitschrift für Körpergeschichte" (Scientific Advisory Board)
  - Journal of Contemporary History (Editorial Board)
  - Journal "European Studies Review" (Advisory Board)
  - Journal "L'Homme: Zeitschrift für Feministische Gesellschaftswissenschaft" (Advisory Board)
  - Journal of Modern History (Advisory Board)
  - Körber Foundation (Board of Trustees), 2016–2020
  - Körber Foundation, German History Competition (Board of Trustees), 2007–2015
  - Leuphana University of Lüneburg, Bachelor Program Liberal Education/Studium Individuale (Advisory Board), 2016–2022
  - Ludwig Boltzmann Institute for the History and Theory of Biography, Vienna (Advisory Board)
  - Scientific Council of the Max Planck Society (Chairperson), 2014–2017
  - Scientific Council of the Max Planck Society (Deputy Chairperson), 2012–2014
  - University Council Konstanz (Member), 2015–
- Gaissmaier, Wolfgang**
- Journal "Frontiers in Quantitative Psychology and Measurement" (Review Editor)
  - Journal "Medical Decision Making" (Editorial Board), 2012–2014

- Gammerl, Benno**
- Archive for Life Stories of LGBTI\* People at Federal Foundation Magnus Hirschfeld (Advisory Board)
  - Berlin Senate, Committee for LGBTI\* History (Advisory Board)
  - Jahrbuch Sexualitäten (Co-Editor), 2015–
  - Network for History and Theory (Member)
  - Scientific Staff Committee of the MPI for Human Development (Member), 2010–2015
- Garrett, Douglas D.**
- Scientific Staff Committee of the MPI for Human Development (Member), 2014–
- Gigerenzer, Gerd**
- Advisory Council of Consumer Affairs (Sachverständigenrat für Verbraucherfragen), German Ministry of Law and Consumer Protection (BMJV) (Member), 2014–
  - American Academy of Arts and Sciences (Foreign Honorary Member), 2016–
  - American Philosophical Society (International Member), 2016–
  - AOK Gesundheitskasse (Advisor), 2014–
  - Berlin-Brandenburg Academy of Sciences and Humanities (Member)
  - BERLIN.MINDS (Advisory Board)
  - BfR Federal Institute for Risk Assessment (Advisory Board)
  - Board of the APS Policies (Advisory Committee of International Scholars)
  - Bundesverband Managed Care e. V. (Advisory Board), 2014–
  - Center for Interdisciplinary Research, Bielefeld (Advisory Board)
  - Centro de Investigación Avanzada en Educación, Universidad de Chile (International Scientific Committee)
  - Ethics Panel, DVFA (Deutsche Vereinigung für Finanzanalyse und Asset Management) (Member), 2014–
  - European Society for Philosophy and Psychology (ESPP) (Advisory Board)
  - German National Academy of Sciences Leopoldina, Section 26 "Psychology and Cognitive Science" (Member)
  - Inspire2Live Foundation, Amsterdam (Member), 2011–2014
  - International Herbert A. Simon Society (Founding Member)
  - International Journal of Psychology (Editorial Board)
  - Joachim Hertz Wirtschaftspreis (Jury Member), 2016
  - Journal of Behavioral Decision Making (Editorial Board)
  - Journal "Decision" (Editorial Board)
  - Journal "Evolution and Human Behavior" (Editorial Board)
  - Journal "Organizational Behavior and Human Decision Processes" (Editorial Board)
  - Journal "Proceedings of the National Academy of Sciences" (Editor)
  - Journal "Psychological Inquiry" (Editorial Board)
  - Journal "Theory and Psychology" (Advisory Editor)
  - Major Advancement in Psychological Science Award, International Union of Psychological Science (Jury Member), 2014–
  - PsyCh Journal [China] (Editorial Board), 2016–2019
  - Risk and Security, Technische Universität München (Advisory Board)
  - Stiftung Gesundheitswissen (Head of Advisory Board), 2015–2016
  - Summer Institute on Bounded Rationality in Psychology and Economics, MPI for Human Development (Co-Director)
  - Taskforce "Wissenschaft, Öffentlichkeit und Medien," National Academy of Sciences Leopoldina (Member)
  - "Unternehmerisches Herz," WirtschaftsWoche & Würth GmbH & Co (Jury Member), 2016
- Hachmann, Wibke**
- Ethics committee of the MPI for Human Development (Member), 2016–
- Hitzer, Bettina**
- Scientific Staff Committee of the MPI for Human Development (Member), 2015–

- Hertwig, Ralph**
- Association for Psychological Science (Fellow)
  - German National Academy of Sciences Leopoldina, Section 26 “Psychology and Cognitive Sciences” (Member)
  - Journal of Behavioral Decision Making (Editorial Board)
  - Journal “Experimental Psychology” (Editorial Board)
  - Journal “Thinking & Reasoning” (Editorial Board)
  - Journal “Topics in Cognitive Science” (Editorial Board), 2016–2017
  - Max Wertheimer Minerva Center for Cognitive Processes and Human Performance, Haifa (Advisory Board)
  - MobileMed: Mobile Consultation and Learning System (Advisory Board)
  - Scientific Commission “Individual Action–Societal Consequences” (Individuelles Handeln–Gesellschaftliche Konsequenzen), German National Academy of Sciences Leopoldina (Member), 2016–
  - Steering Committee of the DFG Priority Program “New Frameworks of Rationality” (Member)
  - Summer Institute on Bounded Rationality in Psychology and Economics, MPI for Human Development (Co-Director)
  - Wilhelm Wundt Society (Elected Member)
- Horn, Sebastian S.**
- Scientific Staff Committee of the MPI for Human Development (Member)
- Jenny, Mirjam A.**
- Equal Opportunities Representative of the MPI for Human Development, 2016–
- Jensen, Uffa**
- Journal “Culturas Psy/PsyCultures” (Editorial Committee)
  - Mailing List H-Soz-u-Kult (Review Editor)
- Kämmer, Juliane**
- Working Group “Progress Test Medizin,” Charité Universitätsmedizin Berlin (Head Research Scientist), 2016–
- Katsikopoulos, Konstantinos V.**
- Journal “Judgment and Decision Making” (Editorial Board), 2014–
- Keller, Monika**
- International Journal of Developmental Science (Advisory Board)
  - Journal “Erwägen, Wissen, Ethik” (Advisory Board)
- Kounine, Laura**
- Internet Portal “History of Emotions: Insights into Research” (Co-Editor), 2014–
- Krappmann, Lothar**
- International Journal of Early Childhood Education (Editorial Board)
- Lau, Sebastian**
- Ausbildungsverbund Fachinformatik Berlin–afib (Coordinator), 2016–
- Laube, Corinna**
- Max Planck Society PhDnet (Executive Representative of the MPI for Human Development), 2016–
- Laukötter, Anja**
- Equal Opportunities Representative of the MPI for Human Development, 2012–2016
  - Internet Portal “History of Emotions: Insights into Research” (Co-Editor)
  - Research group “The healthy self as body capital: Individuals, market-based societies, and body politics in visual twentieth century Europe” (Co-Director), 2016–2021
- Lejarraga, Tomás**
- Journal of Behavioral Decision Making (Editorial Board), 2014–
  - Journal “Frontiers in Psychology: Cognitive Science” (Editorial Board), 2016–
- Lindenberg, Ulman**
- Academia Europaea (Member), 2014–
  - Alexander von Humboldt Foundation (Fellow)
  - American Psychological Association (Fellow, Div. 20)
  - Association for Psychological Science (Fellow)
  - Behavioral Genetics Association (Fellow)
  - CARINA Stiftung (Board of Trustees), 2014–
  - C. L. de Carvalho–Heineken Prize for Cognitive Science (Jury Member), 2016–2020
  - Cognitive Neuroscience Society (Fellow)
  - European Journal of Developmental Science (Editorial Board)
  - Fernand Braudel Senior Fellow, European University Institute, Fiesole, Italy, 2015–2016

- German Institute for International Educational Research (DIPF), Frankfurt a.M. (Scientific Advisory Board), 2008–2016
- German National Academy of Sciences Leopoldina, Section 26 “Psychology and Cognitive Sciences” (Member)
- German Thesis Award (Deutscher Studienpreis), Körber Foundation (Board of Trustees), 2015–2018
- Gerontological Society of America (Fellow)
- GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry (Editorial Board)
- Interdisciplinary Wolfgang Köhler Research Centre on Conflicts in Intelligent Systems, Humboldt-Universität zu Berlin (Scientific Board), 2008–2014
- International Journal of Behavioral Development (Editorial Board)
- International Max Planck Research School on Computational Methods in Psychiatry and Ageing Research (COMP2PSYCH) (Berlin Speaker), 2016–
- International Max Planck Research School on the Life Course (LIFE) (Berlin Speaker)
- International Society for the Study of Behavioural Development (ISSBD) (Executive Committee), 2008–2014
- Jacobs Foundation, Zurich (Board of Trustees)
- Journal “Aging, Neuropsychology, and Cognition” (Editorial Board)
- Journal “Neuroscience & Biobehavioral Reviews” (Editorial Board), 2014–
- Journal “Psychology and Aging” (Editorial Board)
- Journal “Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie” (Advisory Board)
- LIVES National Centre of Competence in Research, funded by the Swiss National Science Foundation (International Scientific Committee), 2010–2014
- Margret M. and Paul B. Baltes Foundation for the Advancement of Research in Developmental Psychology and Gerontology (Board Member)
- Rotman Research Institute, Toronto (Scientific Advisory Committee), 2012–2014
- Wilhelm Wundt Society (Deputy Chair)
- Working Group on Neurobiological and Psychological Factors of Socialization, German National Academy of Sciences Leopoldina and acatech-Council for Engineering Sciences at the Union of the German Academies of Science and Humanities (Member), 2011–2014

**Luan, Shengua**

- Journal “Frontiers in Evolutionary Psychology and Neuroscience” (Review Editor)
- Journal “Frontiers in Psychology: Cognitive Science” (Review Editor)
- Scientific Staff Committee of the MPI for Human Development (Member)

**Mayer, Karl Ulrich**

- Bundesbericht Wissenschaftlicher Nachwuchs (Chair of Advisory Board), 2014–
- Distinguished Annual Lecture at University College Dublin and Trinity College Dublin (Speaker), 2015
- Fernand Braudel Senior Fellow, European University Institute, Fiesole, Italy, 2017
- Goethe University Frankfurt am Main (University Council Member), 2012–2016
- H-ITS-Heidelberg Institute for Theoretical Studies (Member of the Board of Trustees), 2014–
- Interdisciplinary Working Group on the Excellence Initiative, Berlin-Brandenburg Academy of Sciences (Member)
- Institute on Advanced Studies Vienna (Evaluation Committee), 2015
- Leibniz Association (President), 2010–2014
- Mercator Science-Policy Fellowship-Program, Goethe University Frankfurt am Main, Johannes Gutenberg University Mainz, and Technische Universität Darmstadt (Advisory Board), 2015–
- New York University Abu Dhabi (Visiting Professor—Fall Term), 2015–2017
- Nuffield College Oxford (Visiting Fellow), 2014/2015
- Scientific Committee on Demographic Change, German National Academy of Sciences Leopoldina (Member)
- Scientific Committee on Individual Behavior and Collective Consequences, German National Academy of Sciences Leopoldina (Member), 2016–
- Scientific Council Berlin-Brandenburg Academy of Sciences (Member), 2014–2016
- Search Committee for Director, Leibniz-Institute for Educational Trajectories (Chair), 2016–2017

- Svensson Prize of the Royal Swedish Academy of Humanities and Antiquities (Panel Member), 2017
  - The Emperor Otto Prize, City of Magdeburg (Selection Committee)
  - University of Mannheim (University Council Member)
  - University of Potsdam (Advisory Board Bund-Länder-Programme), 2016–
  - Working Group on Population-Based Longitudinal Studies, German National Academy of Sciences Leopoldina (Member), 2014–2015
- Mousikou, Petroula**
- ARC Centre of Excellence in Cognition and its Disorders (CCD), Macquarie University (Associate Investigator)
- Müller, Sven Oliver**
- Interdisciplinary publication series "Die Gesellschaft der Oper: Die Musikkultur europäischer Metropolen im 19. und 20. Jahrhundert" (Co-Editor)
- Nielsen, Philipp**
- Network H-Antisemitism (Review Editor)
- Olsen, Stephanie**
- Royal Historical Society (Fellow), 2015–
  - Society for the History of Children and Youth (Membership Committee), 2012–2015
- Pachur, Thorsten**
- Journal of Behavioral Decision Making (Editorial Board)
  - Journal "Decision" (Editorial Board), 2016–
  - Journal of Experimental Psychology: Learning, Memory, and Cognition (Consulting Editor)
- Pernau, Margrit**
- Berlin Graduate School Muslim Cultures and Societies, Freie Universität Berlin (Principal Investigator), 2016–
  - Concepta—International Research School in Conceptual History and Political Thought (Advisory Board), 2008–2014
  - Freie Universität Berlin, MA Global History (Faculty Member)
  - Geschichte und Gesellschaft: Journal of Historical Social Sciences (Editorial Board)
  - International Max Planck Research School for Moral Economies of Modern Societies (Principal Investigator)
  - Internet Portal "History of Emotions: Insights into Research" (Co-Editor)
  - Journal "Contributions to the History of Concepts" (Editorial Board)
  - Journal "Emotions: History, Culture, Society" (established by Australian Research Council Centre of Excellence for the History of Emotions [CHE]) (Advisory Board)
  - Series "Globalgeschichte. Theorien, Ansätze, Themen" (Co-Editor)
  - The History of Concepts Group (HCG) (Executive Board Member), 2016–
- Pietraszewski, David**
- Journal "Evolution and Human Behavior" (Editorial Board), 2015–
- Pleskac, Timothy J.**
- Association for Psychological Science (Fellow), 2015–
  - Journal of Behavioral Decision Making (Editorial Board), 2014–
  - Journal "Decision" (Editorial Board), 2016–
  - Journal of Experimental Psychology: General (Associate Editor), 2015–
  - Journal "Psychological Science" (Associate Editor), 2016–
- Prestel, Joseph Ben**
- Journal "Body Politics: Zeitschrift für Körpergeschichte" (Editorial Board)
- Prinz, Roman**
- Max Planck Society PhDnet (Executive Representative of the MPI for Human Development), 2013–2016
  - Max Planck Society PhDnet (Steering Group Member), 2015–2016
  - Open Access Ambassador of the MPI for Human Development, 2016
- Riediger, Michaela**
- Ethics Committee of the MPI for Human Development (Member), 2006–2014
  - German Institute for Economic Research (DIW Berlin) (Research Affiliate)
  - Journal "Emotion" (Consulting Editor)
  - Journal "Psychology and Aging" (Consulting Editor)

- Schroeder, Sascha**
- Ethics Committee of the MPI for Human Development (Member)
  - EU-COST Action E-REAd (Workgroup Coordinator), 2014–2018
  - PISA 2018 Reading Expert Group (Member), 2014–2018
  - Scientific Advisory Board for Higher Education Statistics, Federal Statistical Office of Germany (Member)
- Schubenz, Marie**
- Humanistische Akademie Berlin-Brandenburg (Assessor), 2015–
- Schulte–Mecklenbeck, Michael**
- European Association for Decision Making (Steering Committee and Newsletter Editor)
  - Journal of Behavioral Decision Making (Editorial Board), 2014–
- Shing, Yee Lee**
- Journal "Developmental Psychology" (Consulting Editor), 2014–
- Tiffin–Richards, Simon P.**
- College for International Educational Research (CIDER) (Fellow), 2013–2014
- van den Bos, Wouter**
- Journal "Frontiers in Human Neuroscience" (Review Editor), 2014–
  - Journal "Frontiers in Psychology: Decision Neuroscience" (Review Editor), 2014–
  - Journal of Open Psychology Data (Editorial Board)
- Vasilyev, Pavel**
- British Association for Slavonic and East European Studies (BASEES), Study Group of the Russian Revolution (SGRR) (Overseas Member)
- Verrel, Julius**
- Ethics Committee of the MPI for Human Development (Member), 2014–2016
- Wagner, Gert G.**
- Advisory Council for Consumer Affairs (Sachverständigenrat für Verbraucherfragen), German Ministry of Law and Consumer Protection (BMJV) (Member), 2014–
  - DIW Berlin Graduate Center of Economic and Social Research (Faculty Member)
  - German Data Forum (RatSWD) (Member), 2002–2017
  - German Institute for Economic Research (DIW Berlin) (Executive Board), 2011–2018
  - IPD-Work Consortium (Member)
  - Journal of Applied Social Science Studies ("Schmollers Jahrbuch") (Editor-in-Chief), 2014/2015
  - National Academy of Science and Engineering (acatech) (Elected Member), 2015–
  - Project "Good Living in Germany" of the German Government (Advisory Board), 2014–2016
  - Social Science Genetic Association Consortium (SSGAC) (Member), 2015–
  - Technische Universität Berlin (Full Professor of Economics), 2002–2018
  - Working Group "Genetic and Social Causes of Life Chances: New Perspectives on Pathways Connecting the Genome to Social Outcomes" (Member), 2015–2016
- Wertz, Annie E.**
- Ethics Committee of the MPI for Human Development (Member), 2014–
- Woike, Jan**
- Journal "Frontiers in Psychology: Cognitive Science" (Review Editor), 2016–

## 6. Academic Degrees 2014–2016

### Habilitations

**Jensen, Uffa** (2016). *Zuviel der Liebe: Die Weltgeschichte der Psychoanalyse in Berlin, London und Kalkutta 1910–1940*. Freie Universität Berlin.

**Wegwarth, Odette** (2015). *Statistical literacy in medicine: Physicians' and patients' understanding of health statistics in cancer screening and prevention*. Charité Universitätsmedizin Berlin.

### Doctoral Dissertations

**Analytis, Pantelis Pipergias** (2015). *Psychological process models and aggregate behavior*. Humboldt-Universität zu Berlin.

**Bache, Cathleen** (2015). *Out of sight is not out of mind: Infants' processing of moving targets*. Humboldt-Universität zu Berlin.

**Barkoczi, Daniel** (2016). *Ecological rationality of social learning*. Humboldt-Universität zu Berlin.

**Blanke, Elisabeth S.** (2015). *Recognizing others' thoughts and feelings: Empathic skills and their social implications in younger and older adults*. Freie Universität Berlin.

**Brod, Garvin** (2015). *Prior knowledge effects on memory: Neural correlates, developmental differences, and longitudinal dynamics*. Humboldt-Universität zu Berlin.

**Buchner, Moritz** (2015). *Warum weinen? Bürgerliche Trauerkultur in Italien, 1860–1915*. Freie Universität Berlin.

**Davidovic, Stojan** (2016). *The ecology of financial markets: From analogy to application*. Humboldt-Universität zu Berlin.

**Fechner, Hanna Bettine** (2016). *Cognitive foundations of decision making: Grounding behavioral and neural signatures of decisions within cognitive architecture*. Humboldt-Universität zu Berlin.

**Grandy, Thomas H.** (2015). *Prerequisites for a person-centered cognitive psychology and neuroscience*. Humboldt-Universität zu Berlin.

**Hasenäcker, Jana** (2016). *Learning to read complex words: Morphological processing in reading acquisition*. Freie Universität Berlin.

**Hilbrand, Sonja** (2016). *Why care? The impact of ancestral grandparental investments on caregiving and health today*. University of Basel.

**Jarecki, Jana B.** (2016). *Modeling the decision making mind: Does form follow function?* Humboldt-Universität zu Berlin.

**Josef, Anika K.** (2016). *The life span development of decision making*. University of Basel.

**Karch, Julian D.** (2016). *A machine learning perspective on repeated measures: Gaussian process panel and person-specific EEG modeling*. Humboldt-Universität zu Berlin.

**Kause, Astrid** (2016). *Grasping a changing climate: Judgment and behavior in the face of an uncertain phenomenon*. University of Konstanz.

**Keller, Niklas** (2015). *Reducing civilian force protection casualties in stability operations: A fast and frugal heuristics-based approach*. Humboldt-Universität zu Berlin.

**Klipker, Kathrin** (2015). *Developmental perspective on affect dynamics across adolescence: The role of cognitive control, puberty, and affect motivation in adolescent boys*. Humboldt-Universität zu Berlin.

**Kottwitz, Anita** (2014). *Soziale Ungleichheiten der mütterlichen und kindlichen Gesundheit: Die Geburt aus dem Blickwinkel der Soziologie*. University of Cologne.

**Lisofsky, Nina** (2016). *Hormonal influences on the brain in women: The menstrual cycle, hormonal contraceptives, and pregnancy*. Humboldt-Universität zu Berlin.

**Petersen, Malte** (2015). *The relevance of social environments in economic decision making*. Humboldt-Universität zu Berlin.

**Phillips, Nathaniel D.** (2014). *Adaptive information search and judgment strategies in solitary and competitive tasks*. University of Basel.

**Prestel, Joseph Ben** (2015). *Urban emotions? Debates on the city and emotions in Berlin and Cairo (1860–1914)*. Freie Universität Berlin.

**Rajamani, Imke** (2016). *Angry young men: Masculinity, citizenship and virtuous emotions in popular Indian cinema*. Freie Universität Berlin.

**Schröter, Pauline** (2016). *The development of visual word recognition in German bilinguals*. Freie Universität Berlin.

**Steinhoff, Annekatriin** (2015). *Emerging adults' commitment to effectively supportive friendships: A life-span perspective*. University of Münster.

**Tan, Jolene H.** (2016). Process modeling in social decision making. Freie Universität Berlin.

**Wenger, Elisabeth** (2014). Brain plasticity: Temporal dynamics of training-induced gray matter alterations. Humboldt-Universität zu Berlin.

## Master's and Diploma Theses

**Berger, Janek L.** (2015). Motivation-performance linkages in intensive longitudinal data: A continuous time structural equation modeling approach. Freie Universität Berlin.

**Buckmann, Marcus** (2014). An empirical analysis of the performance of simple decision heuristics in dynamic environments. Humboldt-Universität zu Berlin.

**Enggruber, Paul, & Kreis, Felix** (2015). Development of three-dimensional spectrally selective phosphorous magnetic-resonance imaging for analysing metabolism in the human brain. Technische Universität Berlin.

**Fehrmann, Carmen** (2014). When preschoolers know that they do not know: An investigation of neuro-physiological correlates of metacognition. Maastricht University.

**Gerber, Ulrike** (2015). Geschichte und Emotionen— Ihre Rolle in der Indischen Kurrikulumschlacht von 1998 bis 2004: Unterschiedliche Ideen von Nationsidentität und entsprechenden Nationalgefühlen. Historiographie: Feuerball für Emotionen. Freie Universität Berlin.

**Gerloff, Aileen** (2015). Zum Verhältnis von internationalen, globalen und lokalen Einflüssen: Der politische Aufstieg der Zimbabwe African National Union (1963–1980). Freie Universität Berlin.

**Gomilšek, Tamara** (2015). Use of heuristics in environmental decision-making in relation to the Theory of Planned Behavior [in Slovenian]. University of Maribor.

**Grande, Xenia** (2015). Two routes towards successful associative recall: Neural correlates of direct versus iterative recall in healthy older adults. Freie Universität Berlin.

**Hosang, Karl** (2014). Detecting large-scale brain networks of cross-frequency synchronization. Freie Universität Berlin.

**Horvath, Lilla** (2015). The neural correlates of value-based sequential decision-making in uncertain environments. Humboldt-Universität zu Berlin.

**Wulff, Dirk U.** (2015). Information search in experience-based choice and valuation: Challenges and applications. University of Basel.

**Jensen, Daria** (2016). Diffusion tensor imaging analysis of game-based inhibition training in elderly adults. University of Tübingen.

**Johnson, Rachel Z.** (2016). Anti-catholicism and catholicism in nineteenth-century United States and the war of 1898. Freie Universität Berlin.

**Kleinert, Maria-Lisa** (2016). Transcranial alternating current stimulation (tACS): A valid tool for investigating cortical oscillations underlying working memory? Freie Universität Berlin.

**Kosciessa, Julian Q.** (2016). Effects of short-term memory load and task training on the amplitude and abundance of rhythmic neural activity. Humboldt-Universität zu Berlin.

**Kugler, Dimitrij** (2016). A longitudinal experimental study on the training with a violent video game investigating the neural basis of impulsivity using voxel-based morphometry. Leiden University.

**Kvam, Peter** (2014). The time course of preference formation: Quantitative process model predictions for cognitive dissonance effects. Michigan State University.

**Lender, Anja** (2014). Dynamics in inter-brain synchronization while playing piano in duet. University of Vienna.

**Leyk, Beate E.** (2015). Linking sleep and memory in the aging brain: Age-related differences in episodic memory consolidation? Freie Universität Berlin.

**Lichtenberg, Jan Malte** (2016). On regularization and cross validation. Humboldt-Universität zu Berlin.

**Lochstet, Martyna** (2014). Prefrontal thickness predicts spatial cognition performance change in older adults. Freie Universität Berlin.

**Mamerow, Loreen** (2014). Impulsivity, food, control, and the "normalcy" gap: A neural structural investigation of the impulse-control spectrum disorder model of eating disorders. Freie Universität Berlin.

- Merkert, Mona** (2014). Heuristics for environmental decisions. ETH Zurich.
- Meyer, Ann-Kristin** (2016). The impact of maturation and school entry on episodic memory and its neural correlates. Freie Universität Berlin.
- Moeller, Mika Josephine** (2016). Auswirkungen komplexer Graphem-Phonem-Korrespondenzen auf den Leseerwerb: Eine fehleranalytische Auswertung künstlichen Orthografielernens. International Psychoanalytic University, Berlin.
- Oesterheld, Marius** (2016). A translingual ideology of self-improvement: The concept of "character" in the Chinese and Japanese translations of Samuel Smiles' "Self-help." Freie Universität Berlin.
- Perna, Francesca** (2014). Neural and behavioral synchronization in piano duets. University of Trento.
- Radovic, Tara** (2016). Automatic imitation tendencies in whole body movements. Osnabrück University.
- Rauwolf, Gudrun** (2016). Green = benefit? Communicating health risks and with icon arrays: The influence of color. Humboldt-Universität zu Berlin.
- Richert, Anna** (2016). Zusammenhänge von Rechtschreibfehlern in der Produktion und Rezeption. Technische Universität Berlin.
- Roßbach, Dina** (2015). Lernen gegen das Vergessen—Nutzen und Potenziale digitaler Anwendungen zum Erhalt kognitiver Fähigkeiten im höheren Lebensalter: Kognitives Training und ein Videospiele im Vergleich. University of Potsdam.
- Schröer, Frederik** (2016). Debating violence in the face of war: Changes in South Asian buddhist ethics over the long World War II (1933–1945). Freie Universität Berlin.
- Sommer, Verena R.** (2016). Machine learning as a tool to understand age differences in the distinctiveness of neural representations. University of Amsterdam.
- Trauernicht, Mareike** (2016). Cooperation in emergencies: Situational and personal factors influencing cooperation in a social dilemma game. Freie Universität Berlin.
- Werner, Patrick** (2015). The structural correlates of alcohol consumption on the brain of adolescents with different drinking behaviours. Freie Universität Berlin.
- Wiegert, Steffen** (2015). Neuronal avalanches in the human brain: An fMRI study. Humboldt-Universität zu Berlin.
- Wodzicki, Luc** (2015). Conceptualizing "El Gran Turco": Shared semantics in the 15th-century Mediterranean. Freie Universität Berlin.
- Wu, Charley** (2015). When the medium is the message: How presentation formats influence information search. University of Vienna.
- Yang, Tian** (2014). Measurement of image artifacts for simultaneous application of Transcranial Magnetic Stimulation (TMS) and Functional Magnetic Resonance Imaging (fMRI): Depending on the TMS coil position and development of an optimized timing configuration. Technische Universität Berlin.
- Ziemann, Mara** (2015). Searching down the line: Human performance in ordered search problems. Technische Universität Berlin.
- Zilker, Veronika** (2015). The neurodynamics underlying sequential long-term memory retrieval in decision making—a DCM study. Humboldt-Universität zu Berlin.

## 7. Research and Academic Staff 2014–2016

The positions given represent the latest level held at the Institute. This does not apply to adjunct researchers.



**Adolf, Janne**  
Predoc (Diploma in Psychology, 2013, Humboldt-Universität zu Berlin): Statistical modeling of psychological data; multivariate modeling of change; measurement (in-)

variance; methodological strategies and theoretical principles that integrate intra- and interindividual psychological findings. (LIFE/LIP)



**Algorta, Simón**  
Predoc (M.Sc. in Digital Media, 2014, University of Bremen): Sequential decision making under uncertainty, simple decision heuristics. (ABC/Uncertainty)



**Analytis, Pantelis Pipergias**  
Cornell University, Ithaca, and ABC Adjunct (M.A. in Cognitive Science, 2009, EHESS Paris; Dr.rer.nat. in Psychology, 2015, Humboldt-Universität zu Berlin):

Preference learning; stopping rules; search problems; signaling; metacognition; social influence. (ABC)



**Arndt, Agnes**  
Researcher (M.A. in Modern and Contemporary History, 2006, Freie Universität Berlin; Dr.phil. in Modern History, 2012, Freie Universität Berlin): Modern European, especially East Central European, history; comparative and transnational history; history of emotions and historical semantics. (HoE)



**Artinger, Florian**  
Researcher (B.A. [Hons.] in Politics and Economics, 2002, University of Newcastle; M.Sc. in Economics and Management, 2006, Humboldt-Universität zu Berlin;

Dr.phil. in Economics, 2012, Technische Universität Berlin): Valuation under uncertainty; interaction of decision strategy and environment. (ABC)



**Artinger, Sabrina**  
Federal Chancellery, Germany, and ABC Adjunct (M.Sc. in Economics and Management, 2007, Humboldt-Universität zu Berlin; Dr.rer.pol. in Economics, 2011,

Humboldt-Universität zu Berlin): Judgment and decision making; behavioral economics; social rationality; entrepreneurship; leadership. (ABC)



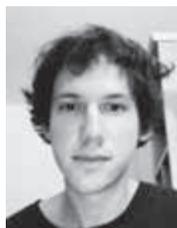
**Assmann, Wolfgang**  
Head of Central IT Unit (Diploma in Business Informatics, 1973, Freie Universität Berlin; Diploma in Pedagogy, 1978, Freie Universität Berlin): Service management in research

institutions; information technology in the social and behavioral sciences.



**Bache, Cathleen**  
Postdoc (Diploma in Psychology, 2008, Humboldt-Universität zu Berlin; Dr.rer.nat. in Psychology, 2015, Humboldt-Universität zu Berlin): Sociocognitive development in infancy;

physiological correlates of early social interaction (EEG, ECG, eye tracking); variability in development; joint action in infants and adults. (LIP)



**Barkoczi, Daniel**  
Postdoc (B.A. [Hons.] in Psychology and Sociology, 2010, University of Westminster; M.Sc. in Cognitive and Decision Sciences, 2011, University College London; Dr.rer.nat. in

Psychology, 2016, Humboldt-Universität zu Berlin): Social learning; information sampling; ecological rationality; evolution and cognition. (ABC)



**Baum, Ina**  
Research Coordinator (B.A. in Communication Studies, International Management, 2007, Hamline University; M.A. in International Relations, 2015, Freie Universität Berlin):

International institutions and negotiations; research administration. (Harding Center)



**Baumert, Jürgen**  
Emeritus (State Examination for Teachers, 1968, Universität Hamburg; Dr.phil. in Classical Philology and Philosophy, 1968, University of Tübingen; Habilitation in Educational

Sciences, 1982, Freie Universität Berlin; Fellow of the Max Planck Society; Director at the Institute until 2010; Honorary Professor of Educational Sciences, Freie Universität Berlin and Humboldt-Universität zu Berlin; Vice President of the Max Planck Society, 2006–2008): Research in learning and instruction; development of cognition and motivation during adolescence and young adulthood; teachers' professional competence; large-scale assessment and international comparison; dynamics of institutional change.



**Becker, Nina**  
Predoc (Diploma in Psychology, 2012, Freie Universität Berlin): Neural basis of episodic memory formation; interindividual differences in associative-memory functioning in adult-

hood and old age; neural correlates of age-related memory changes. (Otto Hahn Research Group)



**Bednarek-Gilland, Antje**  
Researcher (M.Soc.Sc. in Sociology, 2006, Lincoln University; PhD in Sociology, 2012, University of Aberdeen): Sociology of emotions; emotions and decision making. (ARC)



**Beljan, Magdalena**  
 Researcher (M.A. in Literature Studies, History, and Text Technology, 2006, Bielefeld University; PhD in Literature, 2010, University of Luxemburg): History of emotions and of

the body; gender and sexuality; literary theory; media history; homosexuality; masculinity; design history and visual studies; popular culture. (HoE)



**Bender, Andrew R.**  
 Postdoc (B.S. in Psychology, 1998, University of Arizona; M.A. in Experimental Psychology, 2006, San Diego State University; PhD in Psychology, Behavioral & Cognitive Neuroscience, 2013, Wayne State University): Bidirectional influences between brain structure and cognition across the lifespan; structural brain correlates of individual differences in episodic memory; physiological and genetic modifiers of brain-cognition relations. (LIP)



**Benger Alaluf, Yaara**  
 Predoc (B.A. in Jewish Studies and International Relations, 2011, The Hebrew University of Jerusalem; M.A. in Sociology, 2013, The Hebrew University of

Jerusalem): Production and commodification of relaxation in tourism; history and sociology of emotional capitalism; history of tourism. (MEMS/HoE)



**Biermann, Tim**  
 Predoc (M.A. in History, 2010, Bielefeld University): History of music and emotions; cultural studies; theory of history. (MPRG Felt Communities)



**Binder, Julia C.**  
 Postdoc (B.Sc. in Psychology, 2007, University of Basel; M.Sc. in Psychology, 2010, University of Basel; Dr.phil. in Psychology, 2015, University of Zurich): Cognitive training in

healthy old age; cognitive and neural plasticity across the lifespan; developmental processes of learning and memory. (LIP)



**Blanke, Elisabeth S.**  
 Predoc (Diploma in Psychology, 2011, Freie Universität Berlin; Dr.phil. in Psychology, 2015, Freie Universität Berlin): Empathic processes across the lifespan (with a focus on empathic accuracy); (dyadic) social interaction. (MPRG Affect/MNARS)



**Blankenburg, Felix**  
 Freie Universität Berlin and ARC Adjunct (Medical Degree [Approbation], 1998, Charité/Humboldt-Universität zu Berlin; Dr.med., 2001, Freie Universität Berlin): Cognitive neuroscience; neuroimaging; neurocomputation. (ARC)



**Bodammer, Nils C.**  
 Researcher (Diploma in Physics, 1996, Freie Universität Berlin; Dr.rer.nat. in Physics, 2005, Otto von Guericke University Magdeburg; Head of MR Physics): MR-based multiparameter imaging and MR spectroscopy (<sup>1</sup>H and <sup>31</sup>P) in neuroscience and aging research. (LIP)



**Brandmaier, Andreas M.**  
 Researcher (Diploma in Computer Science, 2008, Technische Universität München; Dr.rer.nat. in Computer Science, 2012, Saarland University): Brain-behavior relations across the lifespan; multivariate developmental methodology; formal models of behavioral change; machine learning and data mining; statistical and algorithmic modeling. (LIP/Max Planck UCL Centre)



**Brauer, Juliane**  
 Researcher (M.A. in History and Musicology, 2001, Humboldt-Universität zu Berlin; Dr.phil. in History, 2007, Freie Universität Berlin): Music making as an emotional practice;

music education and singing in Germany; history of education; music and torture; emotions and learning history; culture and practices of remembrance in European contexts; popular history culture. (HoE)



**Brehmer, Yvonne**  
 Otto Hahn Research Group Leader (Diploma in Psychology, 2003, Saarland University; Dr.rer.nat. in Psychology, 2006, Humboldt-Universität zu Berlin): Cognitive plasticity in

childhood and old age; memory training across the lifespan; neural correlates of age-related cognitive changes. (Otto Hahn Research Group)



**Brick, Timothy R.**  
 Postdoc (M.Sc. in Computer Science and Engineering, 2007, University of Notre Dame; PhD in Psychology, 2011, University of Virginia): Synchronization and nonverbal

communication in conversation; affect and facial expression; sensory integration; structural equation modeling; multilevel modeling; machine learning and data mining. (LIP)



**Brighton, Henry**  
 Researcher (B.Sc. [Hons.] in Artificial Intelligence and Computer Science, 1996, University of Edinburgh; M.Sc. in Cognitive Science, 1997, University of Edinburgh; PhD in

Cognitive Science, 2003, University of Edinburgh): Formal and computational models of inference; decision making and language evolution. (ABC)



**Brod, Garvin**  
Postdoc (Diploma in Psychology, 2012, Saarland University; Dr.rer.nat. in Psychology, 2015, Humboldt-Universität zu Berlin): Development of learning and memory; effects of prior

knowledge on memory; brain and learning. (LIP)



**Brose, Annette**  
Humboldt-Universität zu Berlin and LIP Adjunct (Diploma in Psychology, 2006, Freie Universität Berlin; Dr.rer.nat. in Psychology, 2009, Humboldt-Universität zu

Berlin): Intraindividual variability and intraindividual change; linkages between emotion, motivation, and cognition; stress reactivity and affective dynamics. (LIP)



**Buchner, Moritz**  
Predoc (M.A. in History, Italian Philology, and Political Science, 2008, Freie Universität Berlin; Dr.phil. in History, 2015, Freie Universität Berlin): History of emotions; cultural

history of death, grief, and mourning; history of nationalism in Europe; modern history of Germany and Italy. (HoE)



**Buckmann, Marcus**  
Predoc (B.Sc. in Psychology, 2012, Humboldt-Universität zu Berlin; M.Sc. in Psychology, 2014, Humboldt-Universität zu Berlin): Simple prediction models; machine

learning; decision heuristics. (ABC)



**Butler, Oisín**  
Predoc (B.Sc. in Psychology, 2007, Birkbeck, University of London; M.Sc. in Neuroscience, 2010, King's College London): Neural plasticity; structural and functional neuroimaging; combat and stress exposure. (LIFE/LIP)



**Cabanas, Edgar**  
Camilo José Cela University, Madrid, and HoE Adjunct (M.S. in Psychology, 2009, Universidad Autónoma de Madrid; PhD in Psychology, 2013, Universidad Autónoma de

Madrid): Experience design; history of emotions; psychology and sociology of emotions; anthropology and phenomenology of space; political and economic history; critical and cultural theory; theme parks. (HoE)



**Cohrdes, Caroline**  
Researcher (First State Examination in Musicology and Linguistics, 2009, Hanover University of Music, Drama and Media and Gottfried Wilhelm Leibniz Universität Hannover;

Dr.phil. in Music Psychology, 2013, Hanover University of Music, Drama and Media): Musical development across the lifespan; music and emotion; music and identity. (MPRG Affect/MPRG REAd)



**Cokely, Edward T.**  
University of Oklahoma and ABC Adjunct (PhD in Psychology, 2007, Florida State University): Psychology of skilled and informed decision making; numeracy and risk literacy; decision aids and risk communication. (ABC)



**Cole, Whitney G.**  
Postdoc (B.A. in Psychology and French, 2006, Hollins University; M.A. in Experimental Psychology, 2008, College of William and Mary; PhD in Developmental Psychology, 2013,

New York University): Perceptual motor development, motor learning and skill acquisition; locomotion, walking, crawling, and brachiating; interactions between perception, cognition, and action. (LIP)



**Conradt, Larissa**  
National Health Service (NHS), UK, and ARC Adjunct (Diploma in Biology, 1993, University of Tübingen; PhD in Behavioural Ecology, 1998, University of Cambridge): Animal

collective decisions; conflict resolution; evolution of decision behaviors. (ARC)



**Cummins, Stephen**  
Researcher (B.A. in History, 2008, University of Cambridge; M.Phil. in Early Modern History, 2009, University of Cambridge; PhD in History, 2015,

University of Cambridge): History of emotions; history of crime and justice; history of religion; early modern European history; history of southern Italy and Spanish Naples. (HoE)



**Czienskowski, Uwe**  
Researcher (Diploma in Psychology, 1990, Freie Universität Berlin; Dr.phil. in Psychology, 1995, Freie Universität Berlin; Diploma [FH] in Computer Science, 2007, Trier University

of Applied Sciences): Software development for scientific research; experimental design and analysis; meta-analysis; general statistics; philosophy and history of science. (ABC)



**Dahl, Martin J.**  
Predoc (B.Sc. in Psychology, 2011, Justus Liebig University Gießen; M.Sc. in Psychology, 2014, University of Konstanz): Lifespan age differences in rhythmic neural activity,

their anatomical foundations and functional implications; interplay of central norepinephrine and neural oscillations in selective information processing; top-down control over memory in PTSD. (LIFE/LIP)



**Dai, Junyi**  
Postdoc (B.S. in Physics, 2002, Fudan University, Shanghai; M.S. in Experimental Psychology, 2005, East China Normal University; M.A. in Human Factors, 2009, University of

South Dakota; M.S. in Applied Statistics, 2013, Indiana University Bloomington; PhD in Cognitive Psychology, 2014, Indiana University Bloomington): Intertemporal choice; cognitive modeling; Bayesian data analysis. (ARC)



**Dallacker, Mattea**  
Predoc (B.Sc. in Psychology, 2011, Osnabrück University; M.Sc. in Psychology, 2014, Freie Universität Berlin): Food decisions; influence of the social environment on eating behavior; health and food literacy; family meals; parental feeding strategies; childhood obesity. (ARC)



**Danilina, Anna**  
Predoc (M.A. in Political Science, Philosophy, Religious Studies, 2013, Leipzig University): Research on anti-semitism and racism; history of emotions; history of the body; critical theory; postcolonial theory; critical race theory. (MEMS/HoE)



**Davidovic, Stojan**  
Postdoc (B.Sc. in Economics, 2007, Belgrade University; M.Sc. in Operational Research, 2011, Belgrade University; Dr.rer.nat. in Biology, 2016, Humboldt-Universität zu Berlin): Economics as a complex system science; resilience concepts and their application to economic systems; economic crisis; decision making; different rationality concepts. (ABC)



**Delius, Julia A. M.**  
Researcher (State Examination in Medicine, 1988, Universität Hamburg; Dr.med., 1993, Goethe University Frankfurt am Main; Editorial Coordinator, LIFE Newsletter Editor): Interdisciplinary gerontology; editorial projects; scientific coordination. (LIP)



**Driver, Charles C.**  
Predoc (B.A. in Psychological Science [Hons.], 2012, University of Queensland): Time series; continuous time modeling; cross-lagged panel design; structural equation modeling; causality; longitudinal data analysis; panel design; inter- and intraindividual differences; intraindividual changes. (LIFE/LIP)



**Düzel, Sandra**  
Researcher (Diploma in Health Science, 2001, Magdeburg-Stendal University of Applied Sciences; Dr.rer.nat. in Psychology, 2010, Otto von Guericke University Magdeburg): Learning and memory; lifestyle; aging; time perspectives; subjective health horizon; brain structure; cognitive aging; structural neuroimaging. (LIP/Heisenberg Research Group)



**Edelstein, Wolfgang**  
Emeritus (Dr.phil. in Medieval Studies, 1962, Heidelberg University; Fellow of the Max Planck Society; Director at the Institute until 1997; Dr.h.c. in Social Science, University of Iceland; Honorary Professor of Educational Science, Freie Universität Berlin and University of Potsdam): Development and socialization; social-cognitive and moral development and education; democratic competences and citizenship learning; conditions of successful school transformation; developmental and school-related conditions of successful learning.



**Eilers, Sarah**  
Predoc (B.A. in German and English Studies, 2010, University of Göttingen; M.Ed. in German and English, 2013, University of Göttingen): Cognitive language processing; eye tracking comprehension and development; reading in reading research. (MPRG REAd)



**Eitler, Pascal**  
Researcher (M.A. in History, 2001, Bielefeld University and E.H.E.S.S. Paris; Dr.phil. in Modern History, 2008, Bielefeld University): Human-animal relationships in modern history; history of the body and the emotions of the 19th and 20th centuries; history of religion in West Germany. (HoE)



**Ellerbrock, Dagmar**  
Technische Universität Dresden and HoE Adjunct (M.A. in History, Public Law, English Literature and Language, 1993, University of Freiburg; Dr.phil. in Modern History, 1999, Bielefeld University; Habilitation in Modern and Recent History, 2011, Bielefeld University; Minerva Research Group Leader until 09/2014): Modern German and European history; history of European gun culture; history of violence and peace; international relations; history of emotions; gender history; history of law and society. (HoE)



**Ellermann, Christin**  
Researcher (B.A. in Public Health and Sports Science, 2010, University of Bremen; M.Sc. in Public Health, 2012, Freie Universität Berlin): Psychosocial prevention and health promotion; evidence-based nursing and public health. (ABC/Harding Center)



**Elsner, Claudia**  
Postdoc (B.Sc. in Psychology, 2007, Technische Universität Dresden; Diploma in Psychology, 2010, Heinrich Heine University Düsseldorf; PhD in Psychology, 2015, Uppsala University): Developmental psychology; social cognition; evolutionary psychology; infant eye tracking. (MPRG Naturalistic)



information systems, information literacy, classification, bibliometrics.

**Engelhardt, Nicole**  
Academic Librarian (M.A. in Cultural Anthropology, 2001, University of Cologne; Information Specialist, 2003, University of Applied Sciences Potsdam): Scientific electronic



and racial politics; the "Deutschbund" (esp. Max Robert Gerstenhauer). (MEMS/HoE)

**Esche, Alexandra**  
Predoc (M.A. in History, 2015, Freie Universität Berlin): Transnational and comparative history; antisemitism; national socialism and the "Völkisch" movement; "Völkisch" art



development of metacognition and cognitive control across the lifespan; developmental cognitive neuroscience; functional and structural neuroimaging. (LIP)

**Fandakova, Yana**  
Researcher (Diploma in Psychology, 2008, Humboldt-Universität zu Berlin; Dr.rer.nat. in Psychology, 2012, Humboldt-Universität zu Berlin): Learning and memory across the lifespan;



interactions; use of multimodal resources in

**Fantasia, Valentia**  
Postdoc (M.Sc. in Clinical and Dynamic Psychology, 2010, Sapienza University of Rome; PhD in Psychology, 2015, University of Portsmouth, UK): Early caregiver-infant in-

sequentially organised everyday life interactions; infants and young children acquisition and sharing of knowledge on the natural world (such as plants, leaves, flowers); language development. (MPRG Naturalistic)



University of Berlin; Dr.rer.nat. in Psychology, 2016, Humboldt-Universität zu Berlin): Memory and decisions; computational models of cognition; connections to neural correlates; individual and age-associated differences. (ABC/MNARS)

**Fechner, Hanna Bettine**  
Predoc (Diploma in Communication in Social and Economic Contexts, 2005, Berlin University of the Arts [UdK]; Diploma in Psychology, 2011, Humboldt-



and Psychology, 2006, Wright State University, Dayton; PhD in Human Factors and Psychology, 2009, Wright State University, Dayton): Bounded rationality and problem discovery under uncertainty; transparent communication and informed decision making; influence of technology in reasoning and decision processes. (ABC/Harding Center)

**Feufel, Markus A.**  
Charité Universitätsmedizin Berlin and ABC/Harding Center Adjunct (Diploma in Engineering [FH] in Audiovisual Media, 2003, Stuttgart Media University; M.Sc. in Human Factors



domains; individual differences; links between brain structure and high-order metacognitive functions. (LIP)

**Filevich, Elisa**  
Postdoc (M.Sc. in Biological Sciences, 2008, University of Buenos Aires; PhD in Neuroscience, 2013, University College London): Metacognition across perceptual and cognitive



University of California, San Diego; PhD in Cognitive Science,

**Filimon, Flavia**  
Researcher (B.A. [Hons.] in Psychology and French, 2001, University of Auckland; M.Sc. in Cognitive Science, 2004, University of California, San Diego; PhD

2008, University of California, San Diego): Functional neuroimaging; sensorimotor and higher cognitive functions of the human brain; decision making; uncertainty. (ABC)



sampling and social interaction; moral judgment and decision making under uncertainty; bounded rationality and heuristics. (ARC)

**Fleischhut, Nadine**  
Researcher (M.A. in Philosophy, 2006, Freie Universität Berlin; Dr.rer.nat. in Psychology, 2013, Humboldt-Universität zu Berlin): Risk and uncertainty communication; social



Information Science, 1995, Senatsverwaltung für Kulturelle Angelegenheiten Berlin/Cologne): Information management; electronic resources and networked information systems; open access; digital humanities.

**Flitner, Ursula**  
Head of Library and Research Information Unit (M.A. in American Studies and German Literature, 1991, Freie Universität Berlin; State Examination in Library and Informa-



Biological Sciences, 1998, University of Oxford): Science communication. (Harding Center)

**Freeman, Alexandra**  
Winton Centre for Risk and Evidence Communication at Cambridge University and Harding Center Adjunct (M.A. in Biological Sciences, 1995, University of Oxford; D.Phil. in



modern South Asian history; languages and literatures. (MEMS/HoE)

**Freier, Monika**  
Research Coordinator (M.A. in German Literature and South Asian Studies, 2005, Universität Hamburg; Dr.phil. in History, 2013, Freie Universität Berlin): History of emotions;



**Frevert, Ute**  
 Director at the Institute (Dr.phil. in History, 1982, Bielefeld University; Habilitation in Modern History, 1989, Bielefeld University; Fellow of the Max Planck Society; Principal Investigator and Speaker of MEMS; Honorary Professor of History, Freie Universität Berlin):

Modern social, political, and cultural history; history of emotions, gender history. (HoE)



**Frey, Renato**  
 University of Basel and ARC Adjunct (M.Sc. in Psychology, 2008, University of Basel; Dr.phil. in Psychology, 2013, University of Basel):

Decision making under risk and uncertainty; computational modeling of cognition; experience-based decision making; reinforcement/temporal-difference learning; medical decision making, e.g., surrogate decision making. (ARC)



**Gaissmaier, Wolfgang**  
 University of Konstanz and ABC/Harding Center Adjunct (Diploma in Psychology, 2002, Freie Universität Berlin; Dr.phil. in Psychology, 2007

Freie Universität Berlin; Habilitation in Psychology, 2013, Heidelberg University): Judgment and decision making; individual differences in decision making; risk perception and communication; memory-based decision making; medical decision making; ecological rationality; models of heuristics. (ABC/Harding Center)



**Galesic, Mirta**  
 Santa Fe Institute and ABC/Harding Center Adjunct (PhD in Psychology, 2004, University of Zagreb; M.Sc. in Survey Methodology, 2005, University of Maryland and University

of Michigan [Joint Program]): Social learning, social judgments, and cooperation; real-world decision making under uncertainty. (ABC/Harding Center)



**Gammerl, Benno**  
 Researcher (M.A. in Cultural History, 2000, University of London; M.A. in History, 2003, Freie Universität Berlin; Dr.phil. in Modern History, 2008, Freie Universität Berlin):

History of emotions; contemporary history of homosexuality in Germany; oral history; imperial history; citizenship and nationality. (HoE)



**Garcia, Luis-Manuel**  
 University of Birmingham and HoE Adjunct (B.Mus. in Music History and Culture, 2002, University of Toronto; M.A. in Music, 2004, University of Toronto; PhD in Music,

2011, University of Chicago): Electronic dance music; urban music scenes and tourism; affect, touch, and intimacy in music and dance; stranger-sociality in crowds/audiences; sexuality and queer theory. (MPRG Felt Communities/HoE)



**García-Retamero, Rocio**  
 University of Granada and ABC Adjunct (B.A. in Psychology, 2000, University of Jaén; PhD in Psychology, 2005, University of Granada):

Risk perception and communication; shared decision making; physician trust; medical decision making; group decision making; learning. (ABC)



**Garrett, Douglas D.**  
 Senior Researcher (M.A. in Psychology, 2007, University of Toronto; PhD in Psychology, 2011, University of Toronto):

Brain signal variability in relation to lifespan development; cognition; neurochemistry; network dynamics; brain structure. (LIP/Max Planck UCL Centre)



**Gerlach, Philipp**  
 Predoc (M.Phil. in Psychology, 2012, University of Cambridge; M.A. in Social Sciences, 2014, Humboldt-Universität zu Berlin):

Experimental economics; decision and behavioral game theory; meta-analyses; social norms. (LIFE/ARC)



**Gigerenzer, Gerd**  
 Director at the Institute (Dr.phil. in Psychology, 1977, Ludwig-Maximilians-Universität München; Habilitation in Psychology, 1982, Ludwig-Maximilians-Universität

München; Fellow of the Max Planck Society; Director of the Harding Center; Honorary Professor of Psychology, Freie Universität Berlin and Humboldt-Universität zu Berlin; Batten Fellow at the Darden Business School, University of Virginia): Bounded rationality and social intelligence; decisions under uncertainty and time restrictions; competence in risk and risk communication; decision-making strategies of managers, judges, and physicians. (ABC/Harding Center)



**Grandy, Thomas H.**  
 Postdoc (Diploma in Psychology, 2006, Freie Universität Berlin; State Examination for Medicine, 2014, Charité-Universitätsmedizin Berlin; Dr. rer. nat. in Psychology, 2015,

Humboldt-Universität zu Berlin): Oscillatory networks in the human EEG across the lifespan; EEG methods; neuronal correlates of lifespan plasticity and change; identification of cognitive and neural processes at the individual level. (LIP)



**Grolig, Lorenz**  
 Predoc (M.A. in Comparative Literature, Cultural Studies and English Literature, 2011, Justus Liebig University Giessen; Diploma in Psychology, 2013, Justus Liebig University

Giessen): Early reading development; the effects of the home literacy environment on language and reading development; the effects of language interventions in preschool; the influence of musical activities on the development of preschoolers. (MPRG REAd)



**Großmann, Till**  
 Predoc (M.A. in History, 2014, Freie Universität Berlin): History of emotions; history of the self; body history; gender history; history of knowledge. (MEMS/HoE)



**Hachmann, Wibke**  
 Researcher (M.A. in Linguistics, Cognitive Science, Psychology, 2008, University of Freiburg; PhD in Psychology and Cognitive Science, 2012, University of Trento):

Reading development; dyslexia; cross-modal coupling; serial order processing; hebb learning; linear mixed models; connectionism; creativity; representational modality; brain oscillation; eye tracking; aphasiology; theory of mind; spatial cognition. (MPRG REAd)



**Harikos, Wasilios**  
 Postdoc (B.A. in Philosophy and Economics, 2005, University of Bayreuth; M.A. in Philosophy and Economics, 2009, University of Bayreuth; Diploma in Economics, 2009,

University of Bayreuth; Dr.rer.pol. in Economics, 2013, University of Erfurt): Heuristics; learning from experience; stochastic game theory; social preferences. (ABC)



**Hasenäcker, Jana**  
 Researcher (B.A. in German Linguistics and Scandinavian Studies, 2011, Humboldt-Universität zu Berlin; M.A. in Linguistics, 2013, Humboldt-Universität zu Berlin; Dr.phil. in

Psychology, 2016, Freie Universität Berlin): Early reading acquisition; visual word recognition; morphology; cognitive language processing. (MPRG REAd)



**Held, Anna**  
 Research Coordinator (M.A. in German Studies, History, and Linguistics, 2002, University of Cologne): Evidence-based medical research communication. (Harding Center)



**Hertwig, Ralph**  
 Director at the Institute (Diploma in Psychology, 1991, University of Konstanz; Dr.rer.soc. in Psychology, 1995, University of Konstanz; Habilitation in Psychology, 2003, Freie Universität

Berlin; Fellow of the Max Planck Society; Honorary Professor of Psychology, Freie Universität Berlin and Humboldt-Universität zu Berlin): Bounded and social rationality; experience-based decision making; methodology of the social sciences. (ARC)



**Herzfeld-Schild, Marie Louise**  
 Researcher (M.A. in Musicology, Philosophy, and Law, 2007, Heidelberg University; Dr.phil. in Musicology, 2013, Freie Universität Berlin):

Music and emotion; sacred music; ancient, 19th- and 20th-century music, music theory and aesthetics; music and mathematics, philosophy, and psychology; film music. (MPRG Felt Communities)



**Herzog, Stefan M.**  
 Researcher (B.Sc. in Psychology, 2003, University of Basel; M.Sc. in Psychology, 2005, University of Basel; Dr.phil. in Psychology, 2009, University of Basel):

Improving human judgment and decision making using insights from cognitive science, bounded rationality, heuristics, collective intelligence ("wisdom of crowds"), data science, and machine learning. (ARC)



**Heß, Stefan**  
 Predoc (B.Ed. in Mathematics, 2009, University of Potsdam; M.Ed. in Mathematics, 2012, University of Potsdam):

Cognitive basis of spelling and handwriting; spelling and handwriting behavior. (LIFE/MPRG REAd)



**Hinneburg, Jana**  
 Researcher (M.Ed. in Health Sciences, Biology, and Education, 2015, Universität Hamburg): Evidence-based medicine, cancer screening, consumer education, (vocational) education for sustainable development. (ABC/Harding Center)



**Hitzer, Bettina**  
 Minerva Research Group Leader (First State Examination in History and French, 1999, Freie Universität Berlin; Dr.phil. in History, 2004, Bielefeld University): History of emotions; history of migration; history of religion; history of medicine. (HoE)



**Hoffrage, Ulrich**  
 University of Lausanne and ABC Adjunct (Diploma in Psychology, 1989, University of Konstanz; Dr.phil. in Psychology, 1995, University of Salzburg; Habilitation in Psychology, 2001, Freie Universität Berlin): Bounded and social rationality; simple heuristics; (un-)ethical decisions and ethical blindness; risk communication. (ABC)



**Horn, Andreas**  
 Harvard Medical School and ARC Adjunct (State Examination in Medicine, 2011, University of Freiburg; Dr.med., 2012, University of Freiburg): Cognitive neuroscience; neuroimaging (fMRI and DTI); connectomics; movement disorders. (ARC)



**Horn, Sebastian S.**  
 Researcher (Diploma in Psychology, 2007, University of Freiburg; Dr.rer.nat. in Mathematical and Cognitive Psychology, 2012, Heinrich Heine University Düsseldorf):

Development of decision making and memory across the lifespan; prospective and episodic memory; cognitive aging; cognitive modeling of elementary psychological processes (using multinomial models, sequential sampling models). (ARC)



**İlgiz, Çiçek**  
 Predoc (B.A. in History, 2011, Istanbul Bilgi University; M.A. in Cultural Studies Program, 2013, Sabancı University; M.A. in Sociology and Social Anthropology, 2014, Central European University, Budapest): History of psychiatry; urban history; nationalism; religion; secularism. (MEMS/HoE)



**Jacobs, Perke**  
 Predoc (B.Sc. in Economics, 2011, Maastricht University; M.Sc. in Behavioral Science, 2013, Tilburg University): Heuristics for sequential choice; meta-analysis. (ABC)



**Jarecki, Jana B.**  
 Predoc (B.Sc. in Economics, 2012, Ludwig-Maximilians-Universität München; M.Sc. in Psychology, 2012, Ludwig-Maximilians-Universität München; Dr.rer.nat.

in Psychology, 2016, Humboldt-Universität zu Berlin): Classification learning; evolutionary psychology; philosophy of science. (ABC)



**Jenny, Mirjam A.**  
 Head Research Scientist at Harding Center (M.Sc. in Psychology, 2009, University of Basel; Dr.phil. in Psychology, 2013, University of Basel): Judgment and decision making; subjective probability judgment; decision aids in medical decision making; data science; risk literacy and risk communication; computational cognitive modeling; scientific publication processes. (ARC/ABC/Harding Center)



**Jensen, Uffa**  
 Researcher (M.A. in History and Philosophy, 1998, Technische Universität Berlin; Dr.phil. in Modern History, 2003, Technische Universität Berlin; Habilitation in History, 2016, Freie Universität Berlin): History of emotions; history of knowledge and human sciences; transnational history; history of psychoanalysis; history of antisemitism. (HoE)



**Josef, Anika K.**  
 Postdoc (B.Sc. in Psychology, 2011, University of Basel; M.Sc. in Psychology, 2013, University of Basel; Dr.phil. in Psychology, 2016, University of Basel): Lifespan development of decision making; memory-based decisions; risky decision making; neuronal correlates of age differences in decision making. (ARC)



**Kämmer, Juliane E.**  
 Researcher (Diploma in Psychology, 2009, Humboldt-Universität zu Berlin; Dr.rer.nat. in Psychology, 2013, Humboldt-Universität zu Berlin): Medical diagnostic decision making;

heuristics in group decision making; social and ecological rationality; advice seeking and taking. (ARC)



**Karch, Julian D.**  
 Postdoc (Diploma in Computer Science, 2012, Freie Universität Berlin; Dr.rer.nat. in Psychology, 2016, Humboldt-Universität zu Berlin): Multivariate developmental methodology; machine learning and data mining; statistical and algorithmic modeling; model selection and model combination; adapting data mining methods for psychology. (LIP)



**Katsikopoulos, Konstantinos V.**  
 University of Southampton and ABC Adjunct (Diploma in Mathematics, 1992, University of Athens; M.Phil. in Operations Research and Computer Science, 1994, University of Athens; PhD in Industrial Engineering and Operations Research, 1999, University of Massachusetts Amherst): Decision making: prescriptive and descriptive; economic, managerial and health decisions; modeling of human behavior; behaviorally informed policy. (ABC)



**Kause, Astrid**  
 University of Leeds and ABC/Harding Center Adjunct (M.Sc. in Psychology, 2012, University of Klagenfurt; Dr.rer.nat. in Psychology, 2016, University of Konstanz): Decision making under uncertainty, environmental and climate uncertainty and human behavior in the environmental domain; risk communication; social heuristics and fairness. (ABC/Harding Center)



**Keller, Monika**  
 Researcher (Dr.phil. in Psychology, 1974, Heidelberg University; Habilitation in Psychology, 1996, Freie Universität Berlin; Honorary Professor of Psychology, Freie Universität

Berlin): Social and moral development across childhood and adolescence in cross-cultural context; moral cognition and moral emotions; fairness negotiations in groups of different ages and different academic disciplines; social rationality; education of socio-moral competencies. (ABC)



**Keller, Niklas**  
 Charité Universitätsmedizin Berlin and ABC Adjunct (B.Sc. in Psychology, 2003, Goldsmiths—University of London; M.A. in International Relations and Diplomacy, 2004, SOAS

University of London; Dr.rer.nat. in Psychology, 2015, Humboldt-Universität zu Berlin): Medical decision making; military decision making. (ABC)



**Keresztes, Attila**  
Postdoc (M.A. in Political Science and Economics, 2004, Corvinus University of Budapest; PhD in Psychology, 2014, Budapest University of Technology and Economics): Cogni-

tive and neuronal development of episodic memory across the lifespan; the role of cognitive control in forgetting and remembering; interference resolution during episodic memory retrieval; implicit and explicit memory. (LIP)



**Khan, Razak**  
University of Göttingen and HoE Adjunct (B.A. in History, Political Science, English and Hindi Literature, 2005, Kirori Mal College, University of Delhi; M.A. in Modern Indian History, 2007, University of Delhi; M.Phil. in Modern Indian History, 2009, University of Delhi; Dr. phil. in History and Cultural Studies, 2013, Freie Universität Berlin): Space, emotions, and urban histories; politics of minority cultures and the Muslim question in South Asia; comparative intellectual and cultural studies of postcolonial India and Pakistan. (HoE)



**Khosravani, Neda**  
Predoc (B.Sc. in Clinical Psychology, 2006, Shiraz University; M.Sc. in Clinical Psychology, 2010, Shiraz University): Aging-related changes in cognitive function; neural

mechanisms and plasticity of cognitive functions; experience-dependent plasticity. (LIFE/LIP)



**Kleemeyer, Maïke M.**  
Predoc (B.Sc. in Cognitive Science, 2007, Osnabrück University; M.Sc. in Neuroscience, 2010, University of Bremen): Interaction of cognitive and motor skills

across the lifespan; neuroplasticity; successful aging. (LIFE/LIP)



**Kloosterman, Niels A.**  
Postdoc (B.Sc. in Psychology, 2010, University of Amsterdam; M.Sc. in Psychology, 2010, University of Amsterdam; PhD in Cognitive Neurosci-

ence, 2015, University of Amsterdam): Brain mechanisms underlying perceptual-decision making and bistable perception; functional role of neuromodulation in perceptual and cognitive tasks; link between age-related decline in cortical variability and cognitive factors. (LIP/Max Planck UCL Centre)



**Kosciessa, Julian Q.**  
Predoc (B.Sc. in Psychology, 2014, Freie Universität Berlin; M.Sc. in Mind and Brain [Track Brain], 2016, Humboldt-Universität zu Berlin): Neural dynamics; rhythmic

neural activity; brain metabolism; memory; perception; aging; EEG methods. (COMP2PSYCH/LIP)



**Kothiyal, Amit**  
Researcher (M.A. in Statistics, 2005, Indian Statistical Institute, Kolkata; Dr. in Economics, 2012, Erasmus University Rotterdam): Behavioral economics, experimental economics, statistical modeling, machine learning. (ABC)



**Kounine, Laura**  
Postdoc (B.A. [Hons.] in History, 2006, University of Exeter; M.Phil. in Early Modern History, 2007, University of Cambridge; PhD in History, 2013, University of Cambridge): Personhood, identity, self-narratives, and emotions in early modern Europe; history of law; witch trials; gender history; religion. (HoE)



**Krappmann, Lothar**  
Researcher (Dr.phil. in Sociology, 1969, Freie Universität Berlin; Honorary Professor of Sociology of Education, Freie Universität Berlin): Socialization theory; social and moral de-

velopment of children in middle childhood; children's peer interactions, relationships, and groups; links between family and peer relationships; day-care institutions; child rights and children's participation; observational research methodology. (ARC)



**Kruse, Imke**  
Researcher (M.A. in Political Science, Modern History, Communication Studies, 2002, University of Potsdam and Freie Universität Berlin; Dr.phil. in Political Science, 2005, Freie Universität Berlin; LIP Research Manager; LIFE Program Manager): Adult development and migration. (LIP)



**Kühn, Simone**  
University Medical Center Hamburg-Eppendorf and LIP Adjunct (Diploma in Psychology, 2006, University of Potsdam; Dr.rer.nat. in Psychology, 2009, Leipzig University; Habilitation in Psychology, 2012, Humboldt-Universität zu Berlin): Structural and functional neuroimaging; brain plasticity across the lifespan; quantitative meta-analyses. (LIP)



**Kulkarni, Kedar A.**  
Postdoc (B.A. [High Hons.] in English Literature, 2006, Brandeis University; M.A., C.Phil. in Literature, 2009, University of California, San Diego; PhD in Literature, 2013, University of California, San Diego): Postcolonial and world literature; comparative literature; Indian performance traditions; Marathi literature; restoration/18-century theatre; aesthetics and emotions. (HoE)



**Kurvers, Ralf H. J. M.**  
 Researcher (B.Sc. in Forest and Nature Conservation, 2003, Wageningen University; M.Sc. in Ecology and Management, 2005, Wageningen University; PhD in Production Ecology and Resource Conservation, 2011, Wageningen University): Collective decision making; social networks; individual differences; non-human decision making; medical decision making. (ARC)



**Lau, Sebastian**  
 Head of Central IT Unit (Diploma [FH] in Computer Science, 2008, Hochschule Lausitz University of Applied Sciences): Medical imaging processing.



**Laube, Corinna**  
 Predoc (B.Sc. in Psychology, 2011, University of Göttingen; M.Sc. in Psychology, 2014, Heinrich Heine University Düsseldorf): Decision and developmental neuroscience; pubertal

development and hormones; impulsive behavior in adolescence (intertemporal choice); affective decision making. (LIFE/ARC)



**Laukötter, Anja**  
 Researcher (M.A. in Modern History, 2001, Humboldt-Universität zu Berlin; Dr.phil. in Modern History, 2006, Humboldt-Universität zu Berlin): Cultural history and the history

of knowledge in the 19th and 20th centuries; history of emotions; history of ethnology/anthropology and medicine; history of human experiments; history of (post)colonialism; media and cultural theories; history of visualization; history of medical films. (HoE)



**Lee, Joel**  
 Postdoc (B.A. in Religion, 1998, Kenyon College; M.A. in Religion, 2008, Columbia University; PhD in Anthropology, 2015, Columbia University): Dalit religious, intellectual, literary

history; Islam, Hinduism, religions of South

Asia; caste, untouchability, inequality; space, infrastructure, the city; anthropology and history of the senses; Hindi and Urdu literature. (HoE)



**Lein, Ines**  
 Research Coordinator (Diploma in Chemistry, 1995, University of Göttingen; Dr.rer.nat. in Physical Chemistry, 1999, University of Göttingen; Research Coordinator EU Horizon2020 project FORECEE): Medical fact boxes; research communication. (Harding Center)



**Lejarraga, Tomás**  
 University of the Balearic Islands, Palma, and ARC Adjunct (B.A. in Economics, 1999, Washington College; M.Sc. in Management, 2003, Universitat Pompeu Fabra Barcelona; PhD in Management, 2009, Universitat Pompeu Fabra Barcelona): Individual and group judgment and decision making under risk and uncertainty; experience-based choice; learning. (ARC)



**Leuker, Christina**  
 Predoc (M.Sc. in Social, Cognitive, and Affective Neuroscience, 2014, Freie Universität Berlin; B.A. Liberal Arts and Sciences in Psychology and Economics, 2012, Maastricht University): Decisions under risk and uncertainty; the relationship between risk and reward; age effects in value-based decision making. (ARC/MNARS)



**Li, Shu-Chen**  
 Technische Universität Dresden and LIP Adjunct (B.Sc. in Psychology, 1990, Oklahoma City University; M.Sc. in Cognitive Psychology, 1991, University of Oklahoma; PhD in Cognitive Psychology, 1994, University of Oklahoma; Habilitation in Psychology, 2006, Freie Universität Berlin): Neuromodulation of perception, cognition, and motivation; behavioral and brain plasticity; computational neuroscience; stress, brain, and cognition; biocultural co-construction of development. (LIP)



**Lieth, Julia**  
 Predoc (B.A. in History, 2014, Philipps-Universität Marburg; M.Phil. in Early Modern History, 2016, Trinity College Dublin): History of emotions; history of sexuality and the body; cultural and medical history; Anglo-Irish history. (MEMS/HoE)



**Lindenberger, Ulman**  
 Director at the Institute (Dr.phil. in Psychology, 1990, Freie Universität Berlin; Habilitation in Psychology, 1998, Freie Universität Berlin; Fellow of the Max Planck Society; Honorary Professor of Psychology, Saarland University, Freie Universität Berlin and Humboldt-Universität zu Berlin; Co-Director of the Max Planck UCL Centre; Berlin Speaker of LIFE and COMP2PSYCH): Behavioral and neural plasticity across the lifespan; brain-behavior relations across the lifespan; lifespan developmental theory; multivariate developmental methodology; formal models of behavioral change. (LIP/Max Planck UCL Centre)



**Lisofsky, Nina**  
 Predoc (B.Sc. in Psychology, 2010, Freie Universität Berlin; M.Sc. in Psychology, 2012, Freie Universität Berlin; Dr.rer.nat. in Psychology, 2016, Humboldt-Universität zu Berlin): Structural plasticity of the brain across the lifespan; influence of hormones on brain structure; structural plasticity and connectivity of the hippocampus; quantitative meta-analyses of neuroimaging studies. (LIFE/LIP)



**Litvinova, Aleksandra**  
 Predoc (B.Sc. in Psychology, 2012, Maastricht University; M.Sc. in Neuroeconomics, 2014, Maastricht University): Collective decision making; wisdom

of crowds; decisions under uncertainty; decision aids; computational modelling; Bayesian statistics. (ARC)



**Liu, Tian**  
 Postdoc (B.Sc. in Applied Mathematics, 2001, Fudan University, Shanghai; M.Sc. in Statistics, 2004, University of Florida; PhD in Statistics, 2007, University of Florida): Genome-wide association studies (GWAS); assessment of gene–gene and gene–environment interactions; longitudinal and cross-sectional data analysis; applications of Bayesian modeling in statistical genetics. (LIP)



**Lorenz, Robert C.**  
 Postdoc (Diploma in Psychology, 2010, Humboldt-University zu Berlin; Dr.rer.nat. in Psychology, 2015, Humboldt-Universität zu Berlin): Developmental neuroscience; structural and functional brain plasticity; fronto-striatal neural circuitry; neurochemical imaging. (ABC)



**Lövdén, Martin**  
 Karolinska Institutet, Stockholm and LIP Adjunct (B.Sc. in Psychology, 1998, Lund University; PhD in Psychology, 2002, Stockholm University): Cognitive neuroscience; brain and cognition in adulthood and aging; plasticity; cognitive neuroscience; brain and cognition plasticity in adulthood and aging; intervention studies of interactions among behavior, brain, and cognition. (LIP)



**Luan, Shenghua**  
 Senior Researcher (B.A. in Psychology, 1999, Peking University; M.Sc. in Cognitive Psychology, 2002, University of Florida; PhD in Cognitive Psychology, 2004, University of Florida): Heuristics in judgment and decision making; group decision processes and the wisdom of crowds; organizational and managerial decision making; cooperation and human cooperative behavior; moral decisions; applied signal detection theory. (ABC)



**Luong, Gloria**  
 Postdoc (B.A. in Psychology, 2006, University of California, Riverside; M.A. in Social Ecology, 2008, University of California, Irvine; PhD in Psychology and Social Behavior, 2012, University of California, Irvine): Emotion regulation; social relationships; health and well-being; aging. (MPRG Affect)



**Markant, Douglas**  
 Postdoc (B.A. in Psychology, 2005, Cornell University; PhD in Psychology, 2014, New York University): Computational models of learning and decision making; active learning, information foraging; metacognitive decision making; adaptive instruction. (ARC)



**Mårtensson, Johan**  
 Postdoc (M.A. in Social Science, 2007, Lund University; PhD in Psychology, 2012, Lund University): Experience-dependent brain plasticity; language learning. (LIP)



**Martignon, Laura**  
 Ludwigsburg University of Education and ABC Adjunct (Licenciatura en Matemática, 1971, Universidad Nacional de Colombia; Diploma in Mathematics, 1975, University of Tübingen; Dr.rer.nat. in Mathematics, 1978, University of Tübingen; Habilitation in Neural Information Processing, 1998, Ulm University): Mathematical modeling; mathematics education. (ABC)



**Mata, Jutta**  
 University of Mannheim and ARC Adjunct (Diploma in Psychology, 2004, Humboldt-Universität zu Berlin; Dr.rer.nat. in Psychology, 2008, Humboldt-Universität zu Berlin): Obesity; social determinants of eating and food choice; affect; behavior change. (ARC)



**Mata, Rui**  
 University of Basel and ARC Adjunct (Licenciatura in Psychology, 2002, University of Lisbon; Dr.phil. in Psychology, 2006, Freie Universität Berlin): Lifespan development of decision making; individual differences in risky choice under risk and uncertainty. (ARC)



**Mayer, Karl Ulrich**  
 Emeritus (Dr.rer.soc. in Sociology, 1973, University of Konstanz; Habilitation in Sociology, 1977, University of Mannheim; Director at the Institute until 2005; President of the Leibniz Association, 2010–2014; Stanley B. Resor Professor Emeritus of Sociology at Yale University; Honorary Professor of Sociology, Freie Universität Berlin): Social stratification and mobility; comparative analyses of social structures; sociology of the life course; structures and processes of the labor market.



**McDowell, Michelle**  
 Researcher (B.A. [First Class Hons.] in Psychology, 2005, Griffith University, Brisbane; PhD in Psychology, 2011, Griffith University, Brisbane): Risk perception; decision making; judgment; heuristics; rationality. (ABC/Harding Center)



**Meder, Björn**  
 Researcher (Diploma in Psychology, 2003, University of Göttingen; Dr.rer.nat. in Psychology, 2006, University of Göttingen): Causality and causal cognition; information search; categorization; inductive learning; judgment and decision making; bounded rationality; heuristics. (ABC)



**Menniken, Marvin**  
 Predoc (B.A. in Political Science and History, 2012, University of Freiburg; M.A. in History, 2015, Freie Universität Berlin): Political history; history of social movements; global history. (MEMS/HoE)



**Molleman, Lucas**  
 Researcher (B.Sc. in Biology, 2006, University of Amsterdam; M.Sc. in Biology, 2008, University of Amsterdam; M.A. in Philosophy of Biology, 2010, University of Amsterdam; Dr. in Theoretical Biology, 2014, University of Groningen): Social learning; cultural evolution; cooperation; reciprocity; evolutionary dynamics; punishment. (ARC)

dam; Dr. in Theoretical Biology, 2014, University of Groningen): Social learning; cultural evolution; cooperation; reciprocity; evolutionary dynamics; punishment. (ARC)



**Monti, Marco**  
 IBM Italy and ABC Adjunct (PhD in Economics, Bocconi University, Milan): Behavioral and experimental economics; decision making; cognitive factors in human-computer interaction; decision support systems. (ABC)

interaction; decision support systems. (ABC)



**Morais, Ana Sofia**  
 German Centre for Higher Education Research and Science Studies and ABC Adjunct (M.Sc. in Psychology, 2004, University of Lisbon; Dr.rer.nat. in Psychology, 2010, Humboldt-Universität zu Berlin): Information search; causal cognition; judgment and decision making under uncertainty; lifespan development of cognitive abilities; computational modeling in cognition. (ABC)

search; causal cognition; judgment and decision making under uncertainty; lifespan development of cognitive abilities; computational modeling in cognition. (ABC)



**Mousavi, Shabnam**  
 Johns Hopkins Carey Business School and ABC Adjunct (PhD in Economics, 2002, Virginia Polytechnic Institute; PhD in Statistics, 2006, Virginia Polytechnic Institute): Managerial and market irrationalities; behavioral decision

market irrationalities; behavioral decision

theory; axiomatization of bounded rationality; alternative solution concepts; statistical process control; nature of uncertainty; wisdom as a heuristic; characterizing known and unknown; less-is-more phenomena. (ABC)



**Mousikou, Petroula**  
 Researcher (B.A. in Primary Education, 2000, Aristotle University of Thessaloniki; M.A. in Psychology, 2002, Complutense University of Madrid; M.A. in Cognitive Neuropsychology, 2004, Complutense University of Madrid; B.A. in Linguistics, 2005, Complutense University of Madrid; PhD in Cognitive Science, 2009, Macquarie University, Sydney): Reading; computational modelling of reading; speech production; phonetics. (MPRG READ)

Reading; computational modelling of reading; speech production; phonetics. (MPRG READ)



**Moussaïd, Mehdi**  
 Researcher (M.A. in Behavioral and Cognitive Science, 2007, University of Toulouse; PhD in Ethology, 2010, University of Toulouse and ETH Zurich): Crowds; collective behaviors; self-organization; complex systems; collective intelligence; social influence; social networks. (ARC)

self-organization; complex systems; collective intelligence; social influence; social networks. (ARC)



**Mühlroth, Beate E.**  
 Predoc (B.Sc. in Psychology, 2013, Freie Universität Berlin; M.Sc. in Clinical and Health Psychology, 2015, Freie Universität Berlin): Sleep-dependent memory consolidation; age-related changes in sleep and memory. (LIP/MNARS)

related changes in sleep and memory. (LIP/MNARS)



**Müller, Sven Oliver**  
 Max Planck Research Group Leader (M.A. in Modern and Ancient History, 1994, Bielefeld University; Dr.phil. in History, 2001, Bielefeld University; Habilitation in History, 2014, Bielefeld University): History of emotions; comparative history in Europe; cultural history of the 19th and 20th centuries; behavior of the audience in musical life; history and theories of the nationalism; history of vio-

lence; war of extermination of the Wehrmacht in Eastern Europe, field post letters as communication media. (MPRG Felt Communities)

lence; war of extermination of the Wehrmacht in Eastern Europe, field post letters as communication media. (MPRG Felt Communities)



**Müller, Viktor**  
 Researcher (Dr.rer.soc. in Psychology, 1996, University of Tübingen): Lifespan psychology and aging mechanisms; psychophysiology of social interactions; complexity and brain dynamics; cortical synchronization: local and global networks; graph-theoretical approach. (LIP)

and brain dynamics; cortical synchronization: local and global networks; graph-theoretical approach. (LIP)



**Multmeier, Jan**  
 National Association of Statutory Health Insurance Physicians and Harding Center Adjunct (Diploma in Psychology, 2008, Bielefeld University; Dr.phil. in Psychology, 2012, Freie Universität Berlin): Delivery science; judgment and decision making; risk literacy. (Harding Center)

Delivery science; judgment and decision making; risk literacy. (Harding Center)



**Nelson, Jonathan D.**  
 University of Surrey and ABC Adjunct (M.Sc. in Cognitive Science, 2002, University of California, San Diego; PhD in Cognitive Science, 2005, University of California, San

Diego): Human information search and learning; philosophy of science and artificial intelligence approaches to experiment selection; judgment and decision making; relationship of perception and cognition. (ABC)



**Neth, Hansjörg**  
 University of Konstanz and ABC Adjunct (Diploma in Psychology, 1998, University of Freiburg; PhD in Psychology, 2004, Cardiff University): Choice and decision making under risk and uncertainty; ecological rationality; rational task analysis. (ABC)

Choice and decision making under risk and uncertainty; ecological rationality; rational task analysis. (ABC)



**Nielsen, Philipp**  
 Researcher (B.Sc. [First Class Hons.] in International Relations and History, 2005, The London School of Economics and Political Science; M.Sc. [Dist.] in History of International

Relations, 2006, The London School of Economics and Political Science; PhD in History, 2012, Yale University): Political and cultural history; politics and emotions, constitutional theory and law; history of architecture and design; Jewish history; gender studies. (HoE)



**Pachur, Thorsten**  
 Senior Researcher (M.Sc. in Health Psychology, 2002, University of Sussex; Diploma in Psychology, 2002, Freie Universität Berlin; Dr.phil. in Psychology, 2006, Freie Uni-

versität Berlin; Habilitation in Psychology, 2012, University of Basel): Decision making; heuristics; computational modeling; memory; risky decision making; individual differences; information search. (ARC)



**Pernau, Margrit**  
 Senior Researcher (Dr.phil. in Modern History, 1991, Heidelberg University; Habilitation in Modern History, 2007, Bielefeld University; Extraordinary Professor of History, Freie

Universität Berlin): Modern Indian history (18th–20th centuries); history of emotions; history of modern Islam; transnational history; history of entanglement; historical semantics; comparative studies; translation studies; conceptual history. (HoE)



**Oesterheld, Marius**  
 Predoc (B.A. in History and European Ethnology, 2013, Humboldt-Universität zu Berlin; M.A. in Global History, 2016, Freie Universität Berlin und Humboldt-

Universität zu Berlin): Global history; conceptual history; intellectual history; East Asian history; history of late imperial and Republican China. (MEMS/HoE)



**Padalkar, Bhagyashree**  
 Predoc (B.Tech. in Mathematics and Computing, 2016, Indian Institute of Technology Guwahati): Decision making in online social environments; social network analysis. (ABC)

social network analysis. (ABC)



**Phillips, Nathaniel D.**  
 Predoc (B.A. in Mathematics, 2005, Grinnell College; M.Sc. in Psychology, 2010, Ohio University, Athens; PhD in Experimental Psychology, 2014, Uni-

versity of Basel): Information search; decisions under uncertainty; mind as a naive statistician. (ARC)



**Olsen, Stephanie**  
 Postdoc (B.A. [Hons.] in International Studies, 2001, York University; M.A. in History, 2003, University of British Columbia; PhD in History, 2009, McGill University): Modern

social and cultural history of Britain and Empire; history of emotions; gender and family history; history of childhood and youth; history of education and religion. (HoE)



**Pedersen, Arthur Paul**  
 Postdoc (B.A. in Philosophy, 2005, University of Wisconsin-Madison; B.A. in Mathematics, 2005, University of Wisconsin-Madison; M.Sc. in Logic, Com-

putation, and Methodology, 2009, Carnegie Mellon University; PhD in Logic, Computation, and Methodology, 2012, Carnegie Mellon University): Epistemology; normative and behavioral decision theory; game theory; cognitive heuristics; probability theory. (ARC)



**Pietraszewski, David**  
 Postdoc (B.A. in Psychology, 2001, Ithaca College; PhD in Psychology, 2009, University of California, Santa Barbara): Social categorization; psychology of coalitions and alliances;

resource conflict; "Who Said What?" memory confusion paradigm; developmental, social, and cognitive psychology; evolutionary psychology/adaptationism; engineering/task analysis approaches; construct validity, measurement, and reductionism. (ARC)



**Ostwald, Dirk**  
 Freie Universität Berlin and ARC Adjunct (First State Examination in Medicine, 2003, Universität Hamburg; M.Sc. in Neural and Behavioral Sciences, 2006, University of Tübingen; PhD in Psychology, 2010, University of Birmingham; B.Sc. in Mathematics, 2012, FernUniversität in Hagen): Neurocognition; decision making; statistical inference; neuroimaging data analysis. (ARC)

neurocognition; decision making; statistical inference; neuroimaging data analysis. (ARC)



**Pedikis, Dionysios**  
 Postdoc (Diploma in Electrical and Computer Engineering, 2006, Aristotle University of Thessaloniki; PhD in Theoretical Neuroscience, 2011, Aix-Marseille University): Theoretical and cognitive neuroscience; social and affective neuroscience; cognitive science; nonlinear dynamics; complex systems (brain, cognitive, social). (LIP)

theoretical and cognitive neuroscience; social and affective neuroscience; cognitive science; nonlinear dynamics; complex systems (brain, cognitive, social). (LIP)



**Plamper, Jan**  
 Goldsmiths—University of London and HoE Adjunct (B.A. in History, 1992, Brandeis University; PhD in History, 2001, University of California, Berkeley; Dilthey Fellow [Fritz Thyssen

Foundation]): Russian history (19th–20th centuries); history of emotions. (HoE)



**Pleskac, Timothy J.**  
Senior Researcher (B.S. in Psychology, 2000, University of Iowa; M.S. in Psychology, 2002, University of Maryland; PhD in Psychology, 2004, University of Maryland): Judgment and decision making; cognitive and neural models of cognition; learning and memory processes used during judgment and decision making; mathematical psychology. (ARC)



**Prestel, Joseph Ben**  
Freie Universität Berlin and HoE Adjunct (B.A. in History and Political Science, 2008, Freie Universität Berlin; M.A. in Modern History, 2010, Freie Universität Berlin; Dr.phil. in History, 2015, Freie Universität Berlin): History of emotions; urban history; global history, European history, history of the Middle East. (HoE)



**Prindle, John J.**  
Postdoc (B.A. in Economics, 2006, University of California, San Diego; B.Sc. in Psychology, 2006, University of California, San Diego; M.A. in Psychology, 2008, University of Southern California; PhD in Psychology, 2012, University of Southern California): IRT response time modeling; CART analyses with SEM; continuous time modeling with change scores; diffusion modeling. (LIP)



**Prinz, Roman**  
Researcher (B.Sc. in Psychology, 2011, Maastricht University; M.Sc. in Social & Organisational Psychology, 2013, Leiden University): Risk perception and literacy; decision making and judgment (risky environments); bounded rationality; visualization and transfer of scientific evidence. (ABC/Harding Center)



**Raffington, Laurel**  
Predoc (B.Sc. in Experimental Psychology, 2010, University of Bristol; M.Sc. in Social, Cognitive, Affective Neuroscience, 2013, Freie Universität Berlin): Delineating stress-related social disparities in child neuroendocrine development. (LIP)



**Rajamani, Imke**  
Researcher (M.A. in German Language, Literature, and Media, 2011, Universität Hamburg; Dr.phil. in History, 2016, Freie Universität Berlin): History of anger and compassion in popular Indian cinema; emotions and multimedia; theorizing emotions in conceptual history. (HoE)



**Rauer, Antje**  
Researcher (Diploma in Psychology, 2005, Freie Universität Berlin; Dr.phil. in Psychology, 2008, Freie Universität Berlin): Affective competencies and health across adulthood; affective dynamics between social interaction partners; collaborative cognition. (MPRG Affect/Heisenberg Research Group)



**Raz, Naftali**  
Researcher (B.A. in Psychology, 1979, The Hebrew University of Jerusalem; PhD in Psychology, 1985, The University of Texas at Austin; Professor of Psychology and Director of Lifespan Cognitive Neuroscience Program at the Institute of Gerontology, Wayne State University, Detroit): Cognitive neuroscience of aging with emphasis on the influence of vascular risk factors. (LIP)



**Rebitschek, Felix G.**  
Researcher (Diploma [FH] in Media Economics, 2006, Stuttgart Media University; Diploma in Psychology, 2011, University of Leipzig; Dr.rer.nat. in Psychology, 2014, University

of Greifswald): Thinking and reasoning; JDM; causal reasoning; complexity, uncertainty and risk; risk literacy and risk communication. (ABC/Harding Center)



**Riediger, Michaela**  
Heisenberg Research Group Leader (Diploma in Psychology, 1997, Humboldt-Universität zu Berlin; Dr.phil. in Psychology, 2001, Freie Universität Berlin; Habilitation in Psychology, 2011, University of Zurich): Lifespan changes in the interplay of affect, motivation, health, and cognition; development of affective experiences and competencies; social aspects of motivational and affective processes across the lifespan. (MPRG Affect/Heisenberg Research Group)



**Rohrer, Julia M.**  
Predoc (B.Sc. in Psychology, 2014, Leipzig University; M.Sc. in Psychology, 2016, Leipzig University): Determinants of well-being across the life course; personality psychology; automated text analysis. (LIFE/Max Planck Fellow)



**Rozenblatt, Daphne**  
Postdoc (M.A. in History, 2010, University of California, Los Angeles; PhD in History, 2014, University of California, Los Angeles): History of emotions; history of human sciences; legal history; history of the self; modern Europe. (HoE)



**Ruggeri, Azzurra**  
Max Planck Research Group Leader (M.A. in Philosophy, 2008, University of Pisa; PhD in Cognitive Science, 2012, University of Siena; Dr.rer.nat. in Psychology, 2012, Humboldt-Universität zu Berlin): Cognitive development; active learning; ecological learning; information search; exploration strategies; question asking. (ABC/MPRG iSearch)



**Sander, Julia**  
 Predoc (B.Sc. in Psychology, 2010, Freie Universität Berlin; M.Sc. in Health Psychology and Clinical Psychology, 2013, Freie Universität Berlin): Personality development; social

relationships across the lifespan; social participation. (LIFE/Max Planck Fellow)



**Sander, Myriam C.**  
 Minerva Research Group Leader (Diploma in Psychology, 2007, Humboldt-Universität zu Berlin; Dr.rer.nat. in Psychology, 2011, Humboldt-Universität zu Berlin):

Development of perception and memory across the lifespan; neural correlates of developmental change and brain plasticity; EEG methods. (LIP)



**Santoro, Davide**  
 Postdoc (Dottore in Fisica, 1991, Sapienza University of Rome; PhD in Physics, 2004, University of Nottingham):

Developing novel methods for increasing the sensitivity of MRI techniques by means of computer simulation and design of new pulse sequences. (LIP)



**Schaar, Katrin**  
 Research Coordinator (Diploma in Pedagogy, 1992, Technische Universität Berlin; Dr.phil. in Education, 1997, Freie Universität Berlin, BASE-II Coordinator; Online Editor of

BASE-II website): Interdisciplinary gerontology; demographic change. (LIP)



**Schaefer, Sabine**  
 Researcher (Diploma in Psychology, 2001, Freie Universität Berlin; Dr.phil. in Psychology, 2005, Freie Universität Berlin):

Cognitive-motor coordination across the lifespan; behavioral and neural plasticity; ontogenetic changes in behavior regulation. (LIP)



**Schepens, Job J.**  
 Postdoc (B.Sc. in Artificial Intelligence, 2008, Radboud University Nijmegen; M.Sc. in Artificial Intelligence, 2010, Radboud University Nijmegen; PhD in

Language Science, 2015, Radboud University Nijmegen): Reinforcement learning and aging; language learning and linguistic distance; artificial intelligence and cognitive science. (ARC/MNARS)



**Schlegelmilch, Karola**  
 Predoc (Diploma in Visual Arts, Design, 1991, Berlin University of the Arts [UdK]; M.Sc. in Psychology, 2016, Humboldt-Universität zu Berlin):

Infant perception and categorization of naturalistic textures; vision and cognition. (LIFE/MPRG Naturalistic)



**Schmidt, Anne**  
 Researcher (First State Examination in History and German Language and Literature Studies, 1998, Freie Universität Berlin; Dr.phil. in Modern History, 2004, Bielefeld University):

Cultural, economic, and political history; media studies; history of emotions; public history. (HoE)



**Schmiedek, Florian**  
 German Institute for International Educational Research (DIPF) and LIP Adjunct (Diploma in Psychology, 2000, University of Mannheim; Dr.phil. in Psychology, 2003,

Freie Universität Berlin): Cognitive lifespan psychology; intraindividual variability and plasticity of cognitive performance; models for response times; multivariate models for developmental processes; ambulatory assessment and experience sampling. (LIP)



**Schmitterer, Alexandra**  
 Predoc (B.A. in Psychology, 2011, University of Erfurt; M.Sc. in Clinical and Experimental Linguistics, 2013, University of Potsdam):

Language acquisition; meaning comprehension; acquisition of symbolism; reading prediction; handedness. (MPRG REaD)



**Schnädelbach, Sandra**  
 Predoc (M.A. in History, 2010, University of Cologne): History of emotions; history of knowledge; history of science; history of law; history of the 19th and 20th centuries. (HoE)



**Schooler, Lael J.**  
 Syracuse University and ABC Adjunct (M.Sc. in Cognitive Psychology, 1989, Carnegie Mellon University; PhD in Cognitive Psychology, 1993, Carnegie Mellon University):

Adaptation of human memory to the statistical structure of past and present environments; computational models of human memory; memory's role in judgment and prediction tasks. (ABC)



**Schröder, Julia**  
 Postdoc (Diploma in Biology, 2010, Humboldt-Universität zu Berlin; Dr.rer.medic. in Genetics, 2015, Charité Universitätsmedizin Berlin):

Post-transcriptional regulation and its effect on memory of elderly; the effects of stress and socio-economic status on the epigenome and memory/cognition in young age. (LIP)



**Schroeder, Sascha**  
Max Planck Research Group Leader (M.A. in Musicology, 2002, University of Cologne; Diploma in Psychology, 2006, University of Cologne; Dr.phil. in Psychology, 2008, Uni-

versity of Cologne; Habilitation in Psychology, 2011, Freie Universität Berlin): Cognitive processes in language and text comprehension; reading literacy: assessment of micro- and macrostructural reading skills; research in instruction and learning; quantitative and qualitative methods in empirical research. (MPRG REaD)



**Schröer, Frederik**  
Predoc (Mag. in Philosophical and Cultural Studies, 2013, University of Vienna): History of Tibet and India in the 19th and 20th centuries; history of modern Buddhism; global history; historical semantics (MEMS/HoE)



**Schröter, Pauline**  
Predoc (B.A. in Psychology, English and American Studies, 2008, TU Dortmund University; M.Ed. in Psychology and English Education, 2011, TU Dortmund University and Univer-

sity of Newcastle; Dr.phil. in Psychology, 2016, Freie Universität Berlin): German reading acquisition in L2 speakers; visual word recognition and cross-language effects in bilinguals. (MPRG REaD)



**Schubenz, Marie**  
Predoc (M.A. in Modern History, 2012, Technische Universität Berlin; M.A. in Philosophy, 2012; Freie Universität Berlin): History of emotions; history of social movements;

global labour history; humanist philosophy. (MEMS/HoE)



**Schulte-Mecklenbeck, Michael**  
University of Bern and ARC Adjunct (M.A. in Psychology, 1998, University of Salzburg; PhD in Psychology, 2005, University of Fribourg):

Process tracing; food choice; heuristics; decision processes; information acquisition. (ARC)



**Schulze, Christin**  
Postdoc (Diploma in Psychology, 2011, University of Jena; PhD in Psychology, 2015, University of New South Wales): Decisions under uncertainty; probability learning; computational models of learning and decision making; social decision making. (ARC)



**Schuurman, Jan Gerrit**  
Netherlands Enterprise Agency (RVO.nl) and ABC/Harding Center Adjunct (M.A. in Psychology, 1992, University of Groningen; PhD in Educational Technology, 1999, Technical University of Twente): Decision making in health care. (ABC/Harding Center)



**Scirocco, Elisabetta**  
Bibliotheca Hertziana, Rome, and HoE Adjunct (M.A. in Italian Philology, Literature Studies, and Art History, 2004, University of Naples Federico II; PhD in Archeology and Art History, 2009, University of Naples Federico II): Italian art history (middle ages); culture and representation of social orders; religious history, sacrality, and materiality. (HoE)



**Segbers, Jutta**  
Predoc (B.Sc. in Clinical Linguistics, 2011, Bielefeld University; M.Sc. in Clinical Linguistics, 2013, Bielefeld University): Input and language acquisition; reading development, vocabulary acquisition, and the mental lexicon. (MPRG REaD)



**Sela-Teichler, Yael**  
University of Pennsylvania and MPRG Felt Communities Adjunct (B.Mus. in Music, 1999, The Hebrew University of Jerusalem; M.St. in Historical Musicology, 2003, University

of Oxford; D.Phil. in Historical Musicology, 2010, University of Oxford): Sociocultural history of music (16th–19th centuries); German-Jewish history; emotions in aesthetic theories of the Enlightenment; cultural memory; theories of performativity; music as discursive practice. (MPRG Felt Communities)



**Seyed Yahosseini, Kyanoush**  
Predoc (B.Sc. in Computer Science, 2010, University of Freiburg; M.Sc. in Computer Science, 2014, Freie Universität Berlin): Collective intelligence; collective problem solving; judgment propagation. (ARC)



**Shing, Yee Lee**  
University of Stirling and LIP Adjunct (M.A. in Educational Psychology, 2003, University of Georgia, Athens; Dr.rer.nat. in Psychology, 2008, Humboldt-Universität zu

Berlin; Minerva Research Group Leader): Lifespan and developmental psychology theories; development and plasticity of cognitive mechanisms over the lifespan; multivariate analyses of change and variability; neural correlates of cognitive developmental and aging processes. (LIP)



**Şimşek, Özgür**  
University of Bath and ABC Adjunct (M.Sc. in Industrial Engineering and Operations Research, 1997, University of Massachusetts Amherst; M.Sc. in Computer Science,

2004, University of Massachusetts Amherst; PhD in Computer Science, 2008, University of Massachusetts Amherst): Machine learning; artificial intelligence; decision heuristics; complex networks. (ABC)



**Singer, Kerstin**  
Research Coordinator (M.A. in History, Italian and Portuguese Studies, 1997, University of Cologne; PhD in History, 2006, University of Cologne): History of emotions; scientific coordination; modern political and social history; modern Italian history. (HoE)



**Sinodoru, Hagen**  
Predoc (Diploma in Business Administration [FH], 1990, Berlin School of Economics; MBA in General Management, 1995, Anglia Ruskin University, Cambridge): Decision making of institutional investors and heuristic sales strategies. (ABC)



**Skork, Kerstin**  
Head of Public Relations Unit (M.A. in German Literature, Psychology, and Sociology, 2005, Goethe University Frankfurt am Main): Integrated communications; scientific communication; corporate publishing; event management.



**Sommer, Verena R.**  
Predoc (B.Sc. in Cognitive Science, 2013, University of Osnabrück; M.Sc. in Cognitive Neuroscience, 2016, University of Amsterdam): Memory and perception across the lifespan; age-related changes in neural pattern distinctiveness; machine learning; multivariate pattern and representational similarity analysis. (LIFE/LIP)



**Spallek, Anabelle**  
Predoc (M.A. in History, 2009, Universität Hamburg): Modern European cultural and political history; Western music history. (MPRG Felt Communities)



**Spiegelhalter, David John**  
Winton Centre for Risk and Evidence Communication at Cambridge University and Harding Center Adjunct (B.A. in Mathematics, 1974, University of Oxford; M.Sc. in Statistics, 1975, University of London; PhD in Mathematical Statistics, 1978, University of London): Bayesian analysis; risk/uncertainty assessment and communication; education in probability, statistics, and risk; media coverage of statistics and risk. (Harding Center)



**Spiliopoulos, Leonidas**  
Researcher (B.A. in Economics, 1997, Yale University; M.Sc. in International and European Economic Studies, 2003, Athens University of Economics and Business; PhD in Economics, 2008, The University of Sydney): Behavioral economics; experimental economics; game theory; judgment and decision making; neuroeconomics; model selection; computer science; machine learning. (ARC)



**Steiner, Fabian**  
Predoc (M.Ed. in Social Sciences and History, 2013, Freie Universität Berlin): Theories of nationalism; historiography; late Ottoman history. (MEMS/HoE)



**Stevens, Jeffrey R.**  
University of Nebraska-Lincoln and ABC Adjunct (B.Sc. in Biology, 1996, Baylor University; PhD in Ecology, Evolution, and Behavior, 2002, University of Minnesota): Animal cognition; cooperation; evolution of decision making; intertemporal choice, social networks. (ABC)



**Suter, Renata S.**  
Kiron Open Higher Education GmbH and ARC Adjunct (M.Sc. in Psychology, 2008, University of Basel; Dr.phil. in Psychology, 2012, University of Basel): Computational modeling of cognition; theory integration; decision making under risk and uncertainty; intertemporal choice; moral decision making. (ARC)



**Szymanski, Caroline**  
Predoc (B.A. in Neuroscience, 2008, University of Cologne; M.Sc. in Medical Neuroscience, 2010, Charité Universitätsmedizin Berlin): Interpersonal (action) coordination; EEG hyperscanning. (LIP)



**Takao, Makoto Harris**  
Postdoc (B.A. in Japanese, 2011, The University of Western Australia; B.A. [Hons.] in Asian Studies, 2012, The University of Western Australia; PhD in History and Music, 2016, The University of Western Australia): History of emotions; historical ethnomusicology; early music; Japanese cultural history; Jesuit history; Christian missions in Japan in 16th-20th centuries. (HoE)



**Taleb, Nassim N.**  
ABC Adjunct (MBA, 1983, The Wharton School at the University of Pennsylvania; PhD in Management Science, 1998, Paris Dauphine University): Decision making under opacity; epistemology of probability; mathematical expressions of model errors and metaprobability; ancient heuristics and Mediterranean systems of ethics. (ABC)



**Tan, Jolene H.**  
Postdoc (Diploma in Mass Communication, 2004, Ngee Ann Polytechnic; B.A. in Business Management, 2009, Singapore Management University; Dr.phil. in Psychology, 2016,

Freie Universität Berlin): Cooperation; evolutionary psychology; social decision making; cognitive modeling. (ABC)



**Taylor, Brian J.**  
Ulster University and Harding Center Adjunct (B.Sc. in Physics, 1973, Bristol University; Postgraduate Diploma in Social Administration & Social Work, 1981, Ulster University;

PhD in Epidemiology, 2004, Queen's University Belfast): Professional decision making and risk in social work. (Harding Center)



**Tiffin-Richards, Simon P.**  
Researcher (B.Sc. in Psychology, 2006, University of Reading; M.Sc. in Methods in Psychology, 2007, University of Reading; Dr.phil. in Psychology, 2011,

Freie Universität Berlin): Reading acquisition and comprehension; eye movements during reading; English as a foreign language; validity issues in educational research. (MPRG REAd)



**Todd, Peter M.**  
Indiana University and ABC Adjunct (B.A. in Mathematics, 1985, Oberlin College; M.Phil. in Computer Speech and Language Processing, 1986, Cambridge University; M.A. in

Psychology, 1987, University of California, San Diego; PhD in Psychology, 1992, Stanford University): Simple heuristics for decision making; evolution of behavior; food choice; mate choice; search behavior and cognition. (ABC)



**Townsend, Tarlise**  
University of Michigan, Ann Arbor, and Harding Center Adjunct (B.Sc. in Neuroscience and B.A. in Germanic Studies, 2012, Indiana University; Master of Public Policy [M.P.P.],

2015, University of Michigan; PhD in Health Services Organization and Policy, 2016, University of Michigan): Intersections of health, policy, and behavioral science; risk and uncertainty communication in the context of climate change and health. (Harding Center)



**Trippas, Dries**  
Postdoc (B.Sc. in Psychology, 2008, University of Leuven [KU Leuven]; M.Sc. in Experimental Psychology, 2010, University of Leuven [KU Leuven]; PhD in Cognitive Psychology, 2013, Plymouth University): Cognitive modeling; probabilistic inference; reasoning; signal detection theory. (ARC)



**Tump, Alan Novaes**  
Predoc (B.Sc. in Biology, 2013, Bielefeld University; M.Sc. in Biology, 2016, Bielefeld University): Collective decision making; social information usage; mate choice strategies in

nonhuman animals; ultimate aspects of behavior. (ARC)



**Vagharchakian, Laurianne**  
Researcher (M.Sc. in Fundamental Physics, 1999, Pierre and Marie Curie University—Paris 6; PhD in Physics, 2003, Pierre and Marie Curie University—Paris 6): Social behavior, social heuristics, and decision making; proportional reasoning across the lifespan, risk communication, numeracy; cognitive neurosciences (fMRI). (ABC)



**van den Bos, Wouter**  
Researcher (M.A. in Philosophy, 2004, University of Amsterdam; M.Sc. in Cognitive Science, 2006, University of Amsterdam; PhD in Psychology, 2011,

Leiden University): Development; decision making; learning; neuroimaging; computational modeling; connectivity analyses; social behavior. (ARC)



**van der Hoven, Lena**  
Postdoc (M.A. in Musicology, 2013, Humboldt-Universität zu Berlin; Dr.phil. in Musicology, 2013, Humboldt-Universität zu Berlin): Music and emotions; opera of

the 19th century; music aesthetics of the 18th and 19th centuries; music of the Early Modern Period/music and representation; historical performance practice. (MPRG Felt Communities)



**Vasilyev, Pavel**  
Postdoc (B.A. in History, 2009, St. Petersburg State University; M.A. in Central European History and Jewish Studies, 2010, Central European University, Budapest; PhD

[Kandidat Nauk] in Russian History, 2013, St. Petersburg Institute of History of the Russian Academy of Sciences): History of late imperial and early Soviet Russia; history of emotions; history of crime and legal history; history of alcohol and drugs; history of science and medicine; history of the body. (HoE)



**Verrel, Julius**  
Researcher (DEA in Mathematics, 2001, Jussieu, Paris; M.Sc. in Cognitive Neuroscience, 2006, Radboud University Nijmegen; Dr.rer.nat. in Psychology, 2011, Humboldt-Universität zu Berlin): Motor development across

the lifespan; movement variability and coordination; cognitive aspects of motor behavior; neural representation of body and action. (LIP)



**Vidor, Gian Marco**  
 Researcher (PhD in Modern History and Anthropology, 2008, Université de Versailles Saint-Quentin-en-Yvelines and Fondazione Collegio San Carlo—Modena [Joint Program]): History of emotions; history and anthropology of dying, death, and grief; history of childhood; history of the body; social history; history of law; history of religions. (HoE)



**Voelkle, Manuel C.**  
 Humboldt-Universität zu Berlin and LIP Adjunct (Diploma in Psychology, 2004, University of Mannheim; Dr.rer.soc. in Psychology, 2008, University of Mannheim): Longitudinal research methods; structural equation models; learning and skill acquisition; various aspects of differential psychology; evaluation research. (LIP)



**Vogel, Nina**  
 Predoc (Diploma in Psychology, 2011, Heidelberg University; Dr.rer.nat. in Psychology, 2016, Humboldt-Universität zu Berlin): Development of well-being across lifespan; contextual effects on well-being development; modeling of inter- and intraindividual trajectories. (LIFE/Max Planck Fellow)



**von Oertzen, Timo**  
 Universität der Bundeswehr München and LIP Adjunct (Diploma in Computer Science, 1999, Saarland University; B.A. in Psychology, 2001, Saarland University; PhD in Computer Science, 2003, Saarland University; Habilitation in Psychology, 2013, Humboldt-Universität zu Berlin): Optimization of the translation of resources into scientific information by (1) developing methods to optimize study designs and (2) extracting a maximum of information from existing data. (LIP)



**Wagner, Gert G.**  
 Max Planck Fellow (Diploma in Economics, 1978, Goethe University Frankfurt am Main; Dr.rer.oec. in Economics, 1984, Technische Universität Berlin; Habilitation in Economics, 1992, Technische Universität Berlin): Behavioral economics; survey methodology; aging; welfare state.



**Wegwarth, Odette**  
 Senior Researcher (Diploma in Psychology, 2003, University of Potsdam; Dr.rer.nat. in Psychology, 2007, Humboldt-Universität zu Berlin; Habilitation in Medical Sociology, 2015, Charité Universitätsmedizin Berlin; Head Research Scientist at Harding Center until 08/2015; as of 01/2017: ABC Senior Researcher): Medical decision making; risk communication in medicine; patients' and doctors' understanding of risk; influence of transparent medical statistics on patients' and doctors' decisions. (ABC/Harding Center)



**Weichenberger, Markus**  
 Researcher (B.Sc. in Biology, 2011, Freie Universität Berlin; M.Sc. in Medical Neurosciences, 2013, Charité Universitätsmedizin Berlin/Humboldt-Universität zu Berlin): Structural and functional neuroimaging; brain plasticity; psychopathology; theory of neuroscience. (LIP)



**Wellmann, Henning**  
 Predoc (Diploma in Political Sciences and Cultural Sciences, 2009, University of Bremen): Music and emotions; cultural studies; poststructuralist theory. (MPRG Felt Communities)



**Wenger, Elisabeth**  
 Researcher (Diploma in Psychology, 2010, Freie Universität Berlin; Dr.rer.nat. in Psychology, 2014, Humboldt-Universität zu Berlin): Brain plasticity across the lifespan; timing and functional nature of anatomical brain changes; structural neuroimaging. (LIP)



**Werkle-Bergner, Markus**  
 Senior Researcher (Diploma in Psychology, 2004, Saarland University; Dr.rer.nat. in Psychology, 2009, Humboldt-Universität zu Berlin): Lifespan development of memory and cognitive control functions; neuronal correlates of lifespan plasticity and change; EEG methods in lifespan research; multivariate statistical models of variability and change. (LIP)



**Wertz, Annie E.**  
 Max Planck Research Group Leader (B.A. in Psychology, 2003, Boston University; PhD in Psychology, 2009, University of California, Santa Barbara): Developmental and evolutionary approaches to cognition; social learning, social cognition; infancy. (MPRG Naturalistic)



**Wheeler, Gregory**  
 Munich Center for Mathematical Philosophy and ABC Adjunct (M.A. in Philosophy, 1995, Colorado State University; PhD in Philosophy and Computer Science, 2002, University of Rochester): Probability theory (foundations, causal and statistical reasoning); logic (philosophical, computational, applied); cognitive science (judgment and decision making, bounded rationality). (ABC)



**Wiegand, Iris**  
 Postdoc (Diploma in Psychology, 2009, Saarland University; PhD in Systemic Neurosciences, 2013, Ludwig-Maximilians-Universität München): Individual differences, age- and disease-related changes in attention and memory; brain-behavior correlates; visual cognition; computational modeling; electroencephalography. (LIP/Max Planck UCL Centre)



**Włodarczyk, Aleksandra**  
 Predoc (M.A. in Psychology, 2006, University of Gdańsk; Postgraduate Diploma in Advanced Clinical Psychology, 2011, Medical University of Gdańsk):

Social cognition; response to threat in infancy and early childhood; attentional bias to threat. (LIFE/MPRG Naturalistic)



**Woike, Jan K.**  
 Researcher (Diploma in Psychology, 2001, Ruhr-Universität Bochum; Dr.phil. in Psychology, 2008, Ruhr-Universität Bochum): Ecological rationality; human cognition and heuristics; behavioral economics; development of online applications for interactive group research; destructive competition; distributive fairness; decision making in economic and medical contexts; personal identity; philosophy of biology. (ARC)



**Wong, John**  
 Predoc (B.A. in Cognitive Science, 1999, University of Hong Kong; M.A. in Psychology, 2004, University of Hong Kong; M.Sc. in Cognitive Psychology and Neuroscience,

2009, University of Pittsburgh): Stopping behavior in information search; eye tracking. (ABC/MNARS)



**Wu, Charley M.**  
 Predoc (B.A. in Philosophy, 2009, University of British Columbia; M.Sc. in Cognitive Science, 2015, University of Vienna): Information search; exploration-exploitation; adaptive learning; quantifying uncertainty; sampling methods. (ABC/Uncertainty)



**Wulff, Dirk U.**  
 University of Basel and ARC Adjunct (Diploma in Psychology, 2010, Philipps-Universität Marburg; Dr.phil. in Psychology, 2015, University of Basel): Information search; decisions under uncertainty; cognitive modeling; memory. (ARC)



**Yu, Shuli**  
 Postdoc (B.Sc. in Information Systems Management, 2008, Singapore Management University; B.Soc.Sc. in Psychology, 2008, Singapore Management University; M.A. in Psychology, 2013, Michigan State University; PhD in Psychology, 2015, Michigan State University): Judgment and decision making; cognitive modeling; process tracing. (ARC)



**Zalfen, Sarah**  
 Researcher (Diploma in Politics, 2004, Freie Universität Berlin; Dr.phil. in Politics, 2010, Freie Universität Berlin): Music and emotions in community building processes in the 20th century; German political parties; new developments in music education; challenges and new strategies of cultural policy in Europe. (MPRG Felt Communities)



**Zilker, Veronika**  
 Predoc (B.Sc. in Psychology, 2013, Freie Universität Berlin; M.Sc. in Mind and Brain [Track Brain], 2015, Humboldt-Universität zu Berlin): Decision making under risk and uncertainty; lifespan development; experimental methods; cognitive computational neuroscience. (ARC/MNARS)



**Zitzmann, Michael**  
 Researcher (Diploma in Media Computer Science, 2010, Technische Universität Dresden): Human-computer interaction; computer vision; psychology of perception. (ABC/Harding Center)



**Zúñiga Nieto, Carlos**  
 Postdoc (M.A. in Latin American History, 2009, Columbia University; M.Phil. in Latin American History, 2011, Columbia University; Dr.phil. in History, 2016, Columbia University):

History of emotions; history of childhood and youth; history of education and religion; Latin American history; global history; imperial history. (HoE)

## 8. Where Have Our Researchers Gone? New Positions 2014–2016

### Researchers

**Brighton, Henry** 2016, Tilburg University, Netherlands, Assistant Professor  
**Ellerbrock, Dagmar** 2014, Technische Universität Dresden, Germany, Full Professor  
**Gaissmaier, Wolfgang** 2014, University of Konstanz, Germany, Full Professor  
**Galesic, Mirta** 2015, Santa Fe Institute, USA, Associate Professor  
**Herzfeld-Schild, Marie-Luise** 2015, University of Cologne, Germany, Researcher  
**Horn, Andreas** 2014, Charité Universitätsmedizin Berlin, Germany, Researcher  
**Katsikopoulos, Konstantinos V.** 2017, University of Southampton, UK, Associate Professor  
**Kühn, Simone** 2017, University Medical Center Hamburg-Eppendorf, Germany, Full Professor  
**Lejarraga, Tomás** 2016, University of the Balearic Islands, Palma, Spain, Associate Professor  
**Mata, Jutta** 2014, University of Basel, Switzerland, Assistant Professor  
**Mata, Rui** 2014, University of Basel, Switzerland, Assistant Professor  
**Müller, Sven Oliver** 2015, University of Tübingen, Germany, Visiting Researcher  
**Nelson, Jonathan D.** 2017, University of Surrey, Guildford, UK, Lecturer  
**Nielsen, Philipp** 2016, Sarah Lawrence College, Bronxville, NY, USA, Assistant Professor  
**Ostwald, Dirk** 2014, Freie Universität Berlin, Germany, Assistant Professor  
**Rauers, Antje** 2015, Freie Universität Berlin, Germany, Researcher  
**Riediger, Michaela** 2017, Friedrich Schiller University Jena, Germany, Full Professor  
**Schaar, Katrin** 2016, Humboldt-Universität zu Berlin, Germany, Researcher  
**Schaefer, Sabine** 2015, Leipzig University, Germany, Assistant Professor  
**Schooler, Lael J.** 2014, Syracuse University, USA, Full Professor  
**Schulte-Mecklenbeck, Michael** 2015, University of Bern, Switzerland, Lecturer  
**Shing, Yee Lee** 2015, University of Stirling, UK, Lecturer  
**Şimşek, Özgür** 2017, University of Bath, UK, Senior Lecturer  
**Voelkle, Manuel C.** 2015, Humboldt-Universität zu Berlin, Germany, Full Professor  
**Wegwarth, Odette** 2015, Stiftung Gesundheitswissen, Berlin, Germany, CEO  
**Weichenberger, Markus** 2015, Humboldt-Universität zu Berlin, Germany, Research Fellow  
**Zalfen, Sarah** 2014, Ministry of Science, Research and Culture, Brandenburg, Potsdam, Germany, Head of Office

### Postdoctoral Fellows

**Analytis, Pantelis Pipergias** 2016, Cornell University, Ithaca, USA, Postdoctoral Fellow  
**Artinger, Sabrina** 2015, Federal Chancellery, Berlin, Germany, Research Advisor  
**Brick, Timothy R.** 2014, The Pennsylvania State University, USA, Assistant Professor  
**Brod, Garvin** 2016, German Institute for International Educational Research (DIPF)/Learning Support Laboratory at IDEa Center, Frankfurt a.M., Germany, Researcher/Head  
**Cabanas, Edgar** 2016, Camilo José Cela University, Madrid, Spain, Associate Professor  
**Fandakova, Yana** 2014, University of California, Davis & Berkeley, USA, Postdoctoral Fellow  
**Filevich, Elisa** 2015, Leipzig University, Germany, Postdoctoral Fellow  
**Frey, Renato** 2014, University of Basel, Switzerland, Researcher  
**Garcia, Luis-Manuel** 2014, University of Groningen, Netherlands, Assistant Professor  
**Grandy, Thomas H.** 2016, Vivantes Klinikum am Urban, Berlin, Germany, Cardiologist  
**Jenny, Mirjam A.** 2015, National Association of Statutory Health Insurance Physicians, Berlin, Germany, Data Scientist  
**Josef, Anika K.** 2016, VDI/VDE Innovation + Technik, Berlin, Germany, Scientific Consultant  
**Khan, Razak** 2015, University of Göttingen, Germany, Researcher  
**Kounine, Laura** 2016, University of Sussex, Brighton, UK, Assistant Professor  
**Kulkarni, Kedar A.** 2016, Freie Universität Berlin, Germany, Postdoctoral Fellow  
**Lee, Joel** 2016, Williams College, Williamstown, USA, Assistant Professor  
**Lorenz, Robert C.** 2016, The Federal Joint Committee (G-BA), Berlin, Germany, Researcher  
**Luong, Gloria** 2015, Colorado State University, Fort Collins, USA, Assistant Professor  
**Mårtensson, Johann** 2014, Lund University, Sweden, Researcher  
**Morais, Ana Sofia** 2015, German Centre for Higher Education Research and Science Studies (DZHW), Berlin, Germany, Researcher  
**Pedersen, Arthur Paul** 2015, Universität Regensburg, Germany, Research Scientist  
**Perdikis, Dionysios** 2015, Aix-Marseille University, France, Visiting Researcher  
**Prestel, Joseph Ben** 2015, Freie Universität Berlin, Germany, Researcher  
**Prindle, John J.** 2015, University of Southern California, Los Angeles, USA, Postdoctoral Fellow  
**Schepens, Job J.** 2016, Freie Universität Berlin, Germany, Postdoctoral Fellow  
**van der Hoven, Lena** 2015, University of Bayreuth, Germany, Researcher  
**Vasilyev, Pavel** 2017, The Van Leer Jerusalem Institute, Israel, Researcher  
**Wulff, Dirk U.** 2016, University of Basel, Switzerland, Researcher

## **Predocctoral Fellows**

- Blanke, Elisabeth S.** 2015, Humboldt-Universität zu Berlin, Germany, Researcher  
**Buchner, Moritz** 2017, Forum Transregionale Studien, Berlin, Germany, Public Relations and Publications Officer  
**Fechner, Hanna Bettine** 2016, University of Zurich, Switzerland, Researcher  
**Jarecki, Jana B.** 2016, University of Basel, Switzerland, Postdoctoral Fellow  
**Kause, Astrid** 2016, University of Konstanz, Germany, Predocctoral Fellow  
**Lisofsky, Nina** 2016, Agaplesion Diakonieklinikum Rotenburg, Germany, Oncopsychologist  
**Phillips, Nathaniel D.** 2014, University of Konstanz, Germany, Postdoctoral Fellow  
**Schröter, Pauline** 2016, Institute for Educational Quality Improvement (IQB), Berlin, Germany, Researcher  
**Segbers, Jutta** 2016, University of Münster, Germany, Predocctoral Fellow





The Max Planck Institute for Human Development, founded in 1963, is a multidisciplinary research establishment dedicated to the study of human development and education. Its inquiries are broadly defined, encompassing evolutionary, historical, social, and institutional contexts of individual human development from infancy to old age. The disciplines of psychology, history, and education, which reflect the current directors' backgrounds, are enriched by the work of colleagues from behavioral and developmental neuroscience, evolutionary biology, economics, mathematics, computer science, sociology, and the humanities.

The Institute is one of more than 80 research facilities financed by the Max Planck Society for the Advancement of Science (Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.), the core support for which is provided by the Federal Republic of Germany and its 16 states.

The Institute was founded in 1963 by Hellmut Becker, who was joined by Friedrich Edding, Dietrich Goldschmidt, and Saul B. Robinsohn as the first generation of scientific directors in 1964. In the first decade of its existence, the development of educational research and educational policy was at the center of attention.

With the appointment of a second generation of directors in 1973 (Wolfgang Edelstein and Peter M. Roeder), this framework was extended to include basic research in human development and educational processes.

Since the 1980s and with the appointment of a third generation of senior fellows and scientific directors (Paul B. Baltes, 1980; Karl Ulrich Mayer, 1983; Jürgen Baumert, 1996; Gerd Gigerenzer, 1997), research at the Institute has increasingly concentrated on questions of basic research associated with the nature of human development, education, and work in a changing society. At the same time, lifespan developmental and life-course research became part of the Institute's signature profile.

Later developments in the succession of generations were marked by the appointment of Ulman Lindenberger as director of the Center for Lifespan Psychology (2004), placing an emphasis on neural correlates of human behavior and cognitive plasticity, and by the appointment of Ute Frevert as director of the Center for the History of Emotions (2007), adding perspectives from cultural history to the Institute's research agenda on human development.

The appointment of Ralph Hertwig (2012) has further enriched the Institute's research on human decision-making processes, with a special focus on the social environment and changes across the lifespan.

In addition, an increasing number of Max Planck Research Groups contribute to the multi-faceted scientific profile of the Institute.

## **Max-Planck-Institut für Bildungsforschung Max Planck Institute for Human Development**

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