



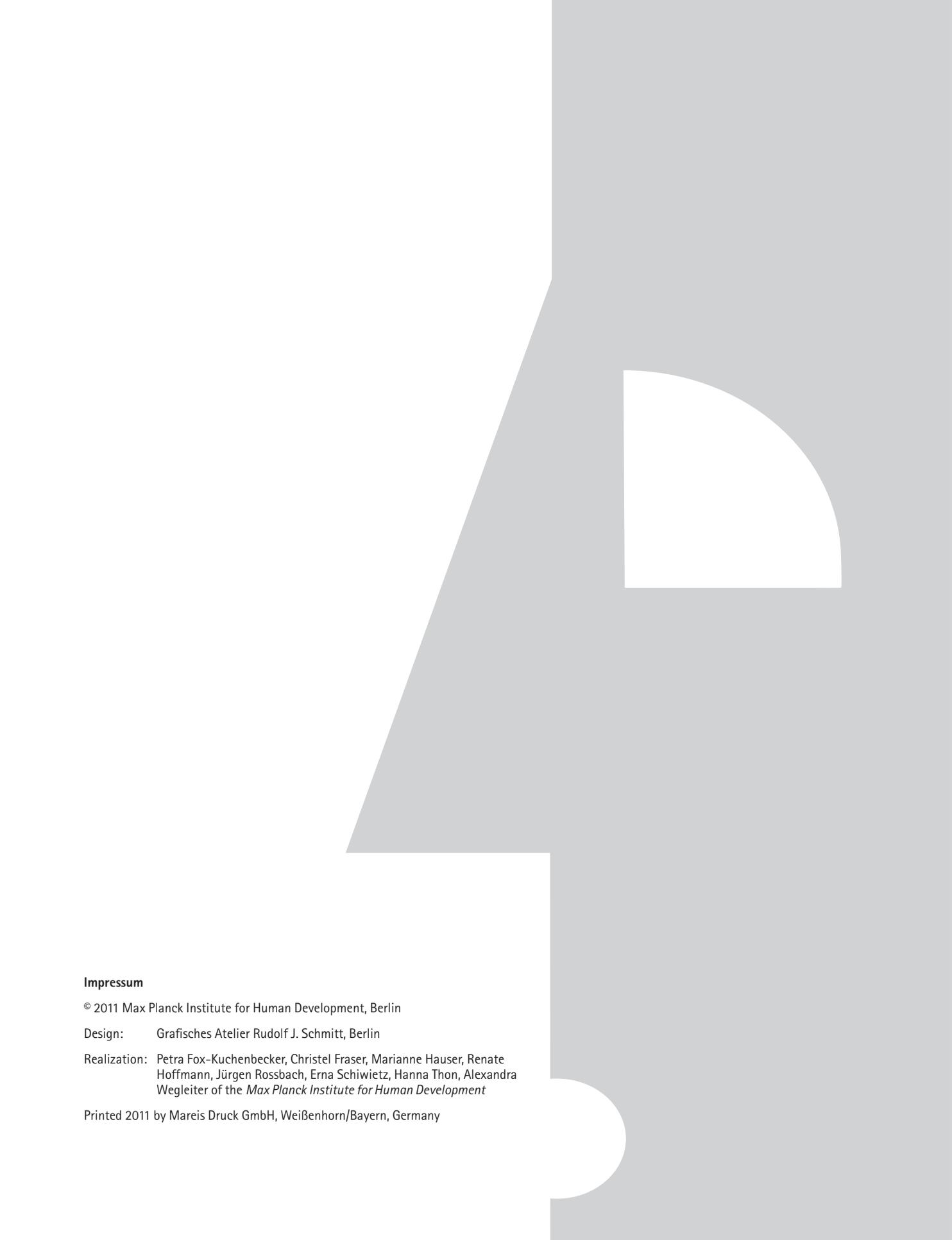
Research Report 2009–2010

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



Research Report 2009–2010



The image features a minimalist abstract design. A large white shape, resembling a stylized letter 'L' or a bracket, is positioned on the left side. The right side of the image is a solid grey field. A white quarter-circle is cut out from the grey field, and another white quarter-circle is cut out from the bottom of the white 'L' shape. The overall composition is clean and modern.

Impressum

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Contents

Introduction	6
Editorial	8
Overview	9
Center for Adaptive Behavior and Cognition	13
Introductory Overview	15
Bounded Rationality	16
Ecological Rationality	21
Social and Evolutionary Rationality	26
Decision Making in the Wild	33
Publications 2009–2010	46
Center for Educational Research	55
Introductory Overview	57
Research Area I: Opportunity Structures of School and Individual Development in Adolescence and Young Adulthood	60
Research Area II: Transitions in the Educational System	71
Research Area III: Reading Literacy and Language Skills	86
Research Area IV: Professional Competence of Teachers and Cognitive Activation in the Classroom	97
Publications 2009–2010	108
Center for the History of Emotions	119
Introductory Overview	121
Research Area: Emotion and Cultivation	130
Research Area: Emotion and the Body	142
Research Area: Emotion and Power	153
Publications 2009–2010	162
Center for Lifespan Psychology	169
Introductory Overview	171
Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior in Adulthood and Old Age (Concluding Report)	177
Research Project 1: Neuromodulation of Lifespan Cognition	183
Research Project 2: Intra-Person Dynamics Across the Lifespan	190
Research Project 3: Cognitive and Neuronal Dynamics of Memory Across the Lifespan (ConMem)	195
Research Project 4: Sensorimotor-Cognitive Couplings	201
Research Project 5: The Berlin Aging Studies (BASE)	207
Research Project 6: Interactive Brains, Social Minds	211
Research Project 7: Formal Methods in Lifespan Psychology	217
Publications 2009–2010	222

Max Planck Research Group	
Neurocognition of Decision Making	231
Research Agenda: Multimodal Approach to the Neurocognition of Decision Making	233
Publications 2009–2010	253
Max Planck Research Group	
Affect Across the Lifespan	257
Introductory Overview	259
Publications 2009–2010	273
Max Planck Research Group	
Felt Communities? Emotions in European Music Performances	275
Introductory Overview	277
Publications 2009–2010	279
International Max Planck Research School	
The Life Course: Evolutionary and Ontogenetic Dynamics (LIFE)	281
Maxnet Cognition	289
Service Units	293
Library and Research Information	295
Information Technology Center	297
Appendix	300
1. Honors and Awards 2009–2010	303
2. Research Colloquia 2009–2010	304
3. Conferences, Workshops, and Seminars 2009–2010	309
4. Political Delegations and Guests 2009–2010	310
5. Visiting Researchers 2009–2010	311
6. Other Professional Activities 2009–2010	314
7. Academic Degrees 2009–2010	318
8. Research and Professional Staff 2009–2010	320
9. Where Have Our Researchers Gone? New Positions 2009–2010	333

Introduction



für Bildungsforschung
Institute for Human Development



Editorial

After a one-year relocation to a nearby building during the major renovations, the Institute moved back to Lentzeallee in mid-March 2009. The improved facilities and fresh colors of the renovated building contributed to all being able to forget the restrictions and shortcomings of the interim site, rapidly resuming research activities. Thus, it came as a real shock in December 2009 when some of the ceiling panels crashed down into the Foyer. Fortunately, nobody was injured, but again, the Institute became a construction site for several months.

Nonetheless, 2009 and 2010 were successful and productive years for the Institute, with numerous research activities and events. In fall 2009, the Institute presented an exhibition honoring the architects of the Institute building, Hermann Fehling and Daniel Gogel. The exhibition, which was made possible by a grant from the Max Planck Society, was the first documentation of the complete works of Fehling and Gogel. In June 2010, the Institute made its debut in the Long Night of the Sciences (Lange Nacht der Wissenschaften). Approximately 1,000 visitors had the opportunity to gain an inside view into the Institute's activities. All research centers as well as the service units became involved and offered accessible information and enjoyable hands-on experiments for the public.

An honor of special importance—for himself and for the whole Institute—was the awarding of the Gottfried Wilhelm Leibniz Prize 2010 to Ulman Lindenberger.

In July 2010, Jürgen Baumert became Director emeritus. At the farewell symposium in honor of this occasion, Annette Schavan, Federal Minister of Education and Research, paid tribute to the person and researcher Jürgen Baumert for his outstanding merits.

In the following pages, detailed information on the structure, programs, and outcomes of the research centers' activities during the reporting period is provided, supplemented by lists and figures in the appendix.

Berlin, February 2011

For the Board of Directors:
Ute Frevert

Overview

The Max Planck Institute 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 education, history, and psychology, 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 about 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 total permanent staff at the Institute is 97, including 24 researchers, supplemented by a varying number of predoctoral, postdoctoral, and affiliated researchers and visiting fellows.

Research Centers

In the 2009–2010 period, research at the Institute was organized primarily in four research centers:

The **Center for Adaptive Behavior and Cognition** (Director: Gerd Gigerenzer) investigates human rationality, in particular decision making and risk perception in an uncertain world. Current research focuses on (1) bounded rationality, that is, the simple heuristics—cognitive, emotional, and behavioral—that laypeople and experts use to make decisions under constraints of limited time and knowledge; (2) social intelligence in cooperation and competition; and (3) risk understanding and uncertainty management in everyday life, including applications in medicine, law, and education. Each of these research areas emphasizes the evolutionary foundations of behavior and cognition, in particular their domain specificity and functional adaptiveness (pp. 13–53).

In April of 2009, the **Harding Center for Risk Literacy** was founded at the Max Planck Institute for Human Development, Berlin. The Center envisions a society of informed citizens who are competent enough to deal with the risks of a modern technological world. The Center's findings shall aid in assessing

risks competently and correctly. Established through a € 1.5 million gift from the London investment banker David Harding, the Center funds research conducted by Prof. Dr. Gerd Gigerenzer. The Max Planck Society, in return, provides the entire infrastructure.

Until July 2010, the **Center for Educational Research** (Director: Jürgen Baumert) examined learning and development from an institutional point of view. Educational settings, such as schools, offer a variety of developmental opportunities, but, at the same time, exclude others. The impact of such settings was investigated from three perspectives: (1) the long-term consequences of schools' opportunity structures on individual development of cognitive competencies as well as motivational and social resources; (2) international comparisons of the outcomes of schooling in the fields of reading comprehension, mathematics, and science literacy; and (3) the improvement of learning and instruction in terms of the cognitive activation of students, mainly in science and mathematics (pp. 55–116).

The **Center for the History of Emotions** (Director: Ute Frevert) examines human emotions. The research rests on the assumption that emotions—feelings and their expression—are shaped by culture and learned in social contexts. A central objective is to trace and analyze the changing norms and rules of feeling in modern societies (18th to 20th centuries). The Center's geographical scope includes both Western and Eastern societies (Europe, North America, and South Asia). Special attention is paid to institutions that have a strong impact on human behavior, such as the family, schools, the workplace, law, religion, the military, and the state (pp. 119–166).

The **Center for Lifespan Psychology** (Director: Ulman Lindenberger) has helped to

establish lifespan psychology as a distinct conceptual approach within developmental psychology. 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 neuronal levels of analysis; and (3) to identify mechanisms of development by exploring age-graded differences in plasticity. While the Center continues to pay special attention to the age periods of late adulthood and old age, which offer unique opportunities for innovation in both theory and practice, it has also intensified its interest in early periods of ontogeny, including infancy and early childhood (pp. 169–228).

Max Planck Fellowship

In June 2008, Gert G. Wagner, professor at the Technical University Berlin and Head of the German Socio-Economic Panel Study (SOEP), was appointed Max Planck Fellow at the Institute. The Max Planck Society established the Fellow Program to further strengthen research cooperation between its institutes and neighboring universities or other research institutions. The cooperation with Gert G. Wagner has allowed researchers at the Institute to investigate selectivity and maintenance of training effects by linking their experimental work, such as cognitive interventions, to longitudinal observations from the SOEP. In addition, innovative survey technologies, such as mobile-phone-based cognitive testing in real-life settings, have been explored and validated.

Max Planck Research Groups

Until fall 2010, the **Max Planck Research Group "Neurocognition of Decision Making"** (Head: Hauke R. Heekeren) investigated mechanisms of decision making in the human brain, using a combination of psychophysical methods, functional and structural neuroimaging, modeling, and pharmacological intervention (pp. 231–254).

The **Max Planck Research Group "Affect Across the Lifespan"** (Head: Michaela

Riediger) was established in January 2009. Its research projects aim at contributing new insights into age-related differences in affective experiences and competencies, focusing primarily on the age range between adolescence and old age. The methodological approach is a combination of a mobile-phone-based experience-sampling technology with psychophysiological monitoring and well-controlled experimental paradigms, and takes into consideration that affective functioning takes place in and is influenced by the individual's social context (pp. 257–273). The **Max Planck Research Group "Felt Communities? Emotions in European Music Performances"** (Head: Sven Oliver Müller) began in mid-2010 to investigate the historical development of the emotions triggered by music in the 19th and 20th centuries. Focusing on emotion as a public form of communication, the Research Group aims to decipher the emotional structure of communities (pp. 275–279).

International Max Planck Research School

An important collaborative effort involving three of the four Centers at the Institute as well as universities in Berlin, the United States, and Switzerland is the **International Max Planck Research School "The Life Course: Evolutionary and Ontogenetic Dynamics (LIFE)"**, which is currently co-chaired by Ulman Lindenberger, MPI for Human Development, Berlin; Patricia A. Reuter-Lorenz, University of Michigan; John R. Nesselroade (until October 2010), then Steven M. Boker (as of October 2010), University of Virginia; and Alexandra M. Freund, University of Zurich. The University of Zurich joined the LIFE Research School in October 2008. This interdisciplinary graduate program brings together doctoral students from the United States and Germany as well as from many other countries (pp. 281–287).

International Max Planck Research Network

In 2008, the Max Planck Society established the **Max Planck Research Network on Cognition** (Maxnet Cognition). Its substantive focus is on the behavioral science, the

behavioral neuroscience, and the computer science of cognition. The main goal of the Network is to foster research cooperation between institutes and across sections of the Max Planck Society on a small number of particularly important research topics in the field of cognition that profit from an interdisciplinary approach. The Steering Committee of the

Network consists of Peter Hagoort, MPI for Psycholinguistics, Nijmegen; Ulman Lindenberger, MPI for Human Development, Berlin; and Arno Villringer, MPI for Human Cognitive and Brain Science, Leipzig. The administration of the Network is located at the MPI for Human Development (pp. 289–291).

Governance of the Institute

The Institute is governed by a **Board of Directors** that consists of the members of the Institute who are Fellows (Wissenschaftliche Mitglieder) of the Max Planck Society. The Board of Directors elects one of the directors 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:

Jürgen Baumert (as of July 2010: Director emeritus)
 Ute Frevert (Managing Director)
 Gerd Gigerenzer
 Ulman Lindenberger (Managing Director until June 2009)

The Board is augmented by one member of the Institute's research staff (Margrit Pernau), the heads of the Max Planck Research Groups (Michaela Riediger and Sven Oliver Müller), and the head of the Administration (Olaf von Maydell).

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), whose members are elected by all researchers.

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 biannually to discuss completed, ongoing, and future research projects at the Institute. In this reporting period, the Board consisted of the following members:

Rajeev Bhargava	<i>CSDS-Centre for the Study of Developing Societies, Dehli, India</i>
Joanna Bourke	<i>Birbeck College, London, UK (as of December 2010)</i>
Christian Büchel	<i>University Medical Center Hamburg-Eppendorf, Germany (until 2009)</i>
Laura L. Carstensen	<i>Stanford University, USA (until 2009)</i>
Hartmut Ditton	<i>Ludwig Maximilians University of Munich, Germany (until 2009)</i>
Jacquelynne S. Eccles	<i>University of Michigan, Ann Arbor, USA</i>
Klaus Fiedler	<i>University of Heidelberg, Germany (until 2009)</i>
Andreas Gestrich	<i>German Historical Institute, London, UK</i>
Reid Hastie	<i>University of Chicago, USA (as of December 2010)</i>
Eric J. Johnson	<i>Columbia University, New York, USA (until 2009)</i>
Ruth Leys	<i>Johns Hopkins University, Baltimore, USA</i>
Herbert W. Marsh	<i>Oxford University, UK</i>
Barbara A. Mellers	<i>University of California at Berkeley, USA (as of December 2010)</i>
Denise Park	<i>University of Texas at Dallas, USA</i>
Manfred Prenzel	<i>Technical University of Munich, Germany</i>
Patricia A. Reuter-Lorenz	<i>University of Michigan, Ann Arbor, USA</i>
Frank Rösler	<i>University of Marburg, Germany</i>
Wolfgang Schneider	<i>University of Würzburg, Germany</i>
Hans Spada	<i>University of Freiburg, Germany (as of December 2010)</i>



**Center for
Adaptive Behavior
and Cognition**

The Center for Adaptive Behavior and Cognition

The **Center for Adaptive Behavior and Cognition** (Director: Gerd Gigerenzer) investigates human rationality, in particular decision making and risk perception in an uncertain world. Current research focuses on (1) bounded rationality, that is, the simple heuristics—cognitive, emotional, and behavioral—that laypeople and experts use to make decisions under constraints of limited time and knowledge; (2) social intelligence in cooperation and competition; and (3) risk understanding and uncertainty management in everyday life, including applications in medicine, law, and education. Each of these research areas emphasizes the evolutionary foundations of behavior and cognition, in particular their domain specificity and functional adaptiveness.



Research Staff 2009–2010

Henry J. Brighton, Uwe Czienskowski, Mario Fific, Wolfgang Gaissmaier, Mirta Galesic, **Gerd Gigerenzer**, Konstantinos V. Katsikopoulos, Monika Keller, Elke Kurz-Milcke (until April 2009), Jonathan D. Nelson, Hansjörg Neth, Henrik Olsson, José Quesada, Lael J. Schooler, Jeffrey R. Stevens, Kirsten G. Volz (as of August 2010: University of Tübingen), Odette Wegwarth

Postdoctoral Fellows

Bryan Bergert, Yen-Sheng Chiang (until May 2009), Edward Cokely (until August 2010), Juliet A. Conlin (until June 2010), Markus A. Feufel, Linnea Karlsson (as of August 2010: Umeå University, Sweden), Fabrice Le Lec (as of September 2009: Catholic University of Lille, France), Julian N. Marewski, Björn Meder, Marco Monti (as of July 2010: Catholic University of Sacred Heart of Milan, Italy), Angela Neumeyer-Gromen (as of July 2009: German Hospital Federation, DKG, Berlin), Özgür Simsek, Max Wolf, Wei Zhu (as of September 2010: Tongji University, Shanghai, China)

Predocctoral Fellows

Florian Artinger, Nicolai Bodemer, Nadine Fleischhut, Juliane Kämmer, Ana Sofia Morais (LIFE) (as of May 2010: Center for Lifespan Psychology), Jan Multmeier, Pantelis Pípergias Analytis, Azzurra Ruggeri, Jenny Volstorf (until June 2010)

Adjunct Researcher

Edward Cokely (Michigan Technological University, USA), Jörg Rieskamp (University of Basel, Switzerland)

Visiting Researchers

Rocio Garcia-Retamero (University of Granada, Spain), Kevin Gluck (Air Force Research Laboratory, USA), Vinod Goel (York University, Toronto, Canada), Marco Monti (Catholic University of Sacred Heart of Milan, Italy), Shabnam Mousavi (Georgia State University, Atlanta, USA), Peter Todd (Indiana University, Bloomington, USA)

Introductory Overview

The Center for Adaptive Behavior and Cognition (ABC) investigates reasoning and decision making under uncertainty at the levels of both individuals and social groups. The research group consists of psychologists, mathematicians, computer scientists, evolutionary biologists, economists, and researchers from other fields. Using a range of methodologies, such as experimental methods, computer simulation, and mathematical analysis, we cooperate in solving the same problems. The ABC program combines a strong theoretical focus with practical applications, that is, the research group both develops specific models and explores their applications. Applications range from helping physicians and patients understand the statistical evidence arising from medical research; helping courts, administrators, and legislators understand the importance of heuristic thinking in the law; and improving teaching practices in statistical education by introducing transparent representation formats. The theoretical focus is on rationality and can be, albeit artificially, divided into 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. This program is an alternative to the dominant optimization paradigm in cognitive science, economics, and behavioral biology that poses the question of how Laplacean superintelligences or near omniscient beings would behave. We study the proximal mechanisms of bounded rationality, that is, the adaptive heuristics that enable quick and frugal decisions 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. The 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 reasoning, both descriptive and normative. In short, we study the adaptation of mental and social strategies to real-world environments rather than compare human judgments to the laws of logic and probability theory.

Social Rationality

Social rationality is a variant of ecological rationality, one for 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. There is a variety of goals and heuristics 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 one can defend with argument or moral justification or those that can create a consensus. To a much greater extent than the cognitive focus of most research on bounded rationality, socially adaptive heuristics include 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 limited time, knowledge, and computational capacities. We do not conceive bounded rationality as optimization under constraints nor do we think of bounded rationality as the study of how people fail to meet normative ideals. Rather, bounded rationality is the key to understanding how people make decisions without utilities and probabilities. Bounded rationality consists of simple step-by-step rules that function well under the constraints of limited search, knowledge, and time—whether an optimal procedure is available or not. Just as a mechanic will pull out specific wrenches, pliers, and gap gauges to maintain an engine rather than just hit everything with a hammer, different tasks require different specialized tools. The notion of a toolbox full of unique single-function devices lacks the beauty of Leibniz' dream of a single all-purpose inferential power tool. Instead, it evokes the abilities of a craftsman, who can provide serviceable solutions to almost any problem with just what is at hand.

The Adaptive Toolbox

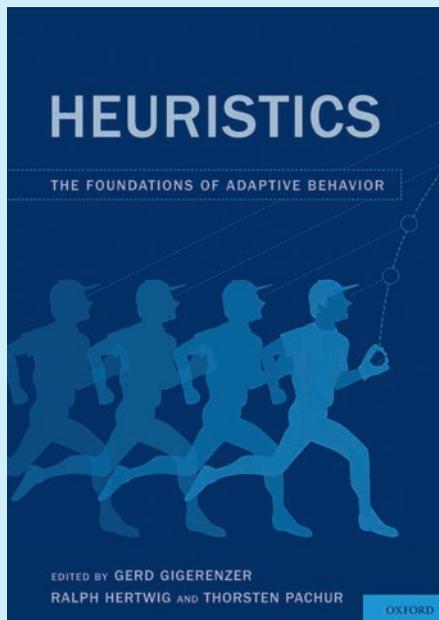
This repertoire of specialized cognitive mechanisms, which include fast and frugal heuristics, are shaped by evolution, learning, and culture for specific domains of inference and reasoning. We call this collection of mechanisms the "adaptive toolbox." We clarify the concept of an adaptive toolbox as follows:

- It refers to a specific group of rules or heuristics rather than to a general-purpose decision-making algorithm.

- These heuristics are fast, frugal, and computationally cheap rather than consistent, coherent, and general.
- These heuristics are adapted to particular environments, past or present, physical or social.
- The heuristics in the adaptive toolbox are orchestrated by some mechanism reflecting the importance of conflicting motivations and goals.

Fast and frugal heuristics generally consist of three building blocks: simple rules for guiding

New Book! *Heuristics: The Foundations of Adaptive Behavior*



How do people make decisions when time is limited, information is unreliable, and the future is uncertain? In other words, how do people reason when optimization is out of reach? This is the central question that *Heuristics: The foundations of adaptive behavior* (2011) addresses. Nobel laureate Herbert A. Simon once said that his entire scientific career was driven by this single question. Based on Simon's work, and with the help of colleagues around the world, the Adaptive Behavior and Cognition (ABC) Research Group at the Max Planck Institute for Human Development in Berlin has developed a research program dedicated to the study of simple heuristics.

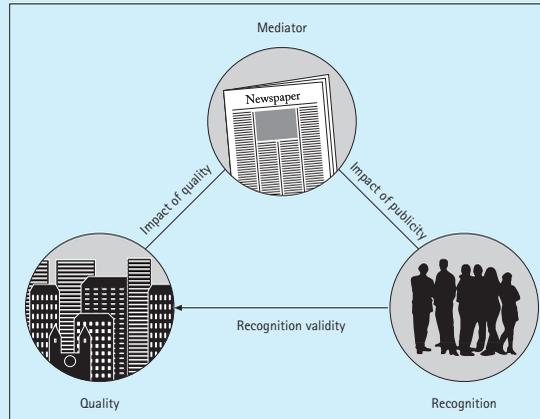
Providing a fresh look at how the mind works as well as the nature of rational behavior, this program has stimulated a large body of research; led to fascinating applications in fields as diverse as law, medicine, business, and sports; and instigated controversial debates in psychology, philosophy, and economics. In a single volume, this book brings together key articles that have been previously published in journals across many disciplines. These articles span theory, applications, and experimental studies, contributing, in the words of Simon (1999), "to this revolution in cognitive science, striking a great blow for sanity in the approach to human rationality."

Box 1.

A Flood of Research on the Recognition Heuristic

Marewski, Pohl, and Vitouch (2010) edited three special issues of the open source journal *Judgment and Decision Making* on recognition processes in inferential decision making. These special issues feature articles on a simple decision strategy that operates on recognition processes: Goldstein and Gigerenzer's (2002) recognition heuristic. The second issue provides an overview of past, present, and likely future debates on the recognition heuristic. A third issue is forthcoming in 2011.

The recognition heuristic predicts that people with less knowledge can make more accurate decisions than those with more. This prediction was tested by BBC Radio 4 in May 2009, when listeners in New York and London were asked which of Detroit or Milwaukee has a larger population. Initially skeptical about the BBC's ability to run a tightly controlled study, we were delighted that they reported only 65% of listeners in New York correctly answered "Detroit," compared to 82% of listeners in London.



Box 2.

search for information (in memory or in the environment), for stopping search, and for decision making. They are effective when they exploit the structure of the information in the environment. That is, their rationality is a form of "ecological rationality" rather than one of consistency and coherence. We continue to explore fast and frugal heuristics and their importance in diverse disciplines, such as biology, economics, and cognitive psychology. In addition, we have applied our basic research in the areas of consumer behavior, election forecasting, and medical decision making. A collection of 40 landmark articles spanning theoretical foundations and real-world applications now appear in revised form and in a single volume, *Heuristics: The foundations of adaptive behavior* (Oxford University Press, 2011, see Box 1). In addition, in 2010, the journal *Judgment and Decision Making* devoted two special issues to the analysis and use of a single heuristic, the recognition heuristic, and a third issue is forthcoming (see Box 2). In what follows, we describe some of the major developments in the understanding of the adaptive toolbox in the past 2 years.

Fast and Frugal Trees

In recollecting September 11, 2001, Louis Cook of the Emergency Medical Services Division of the New York City Fire Department noted how the triage system *Simple Triage and Rapid Treatment* (START) helped his team prioritize victims and identify the ones who needed help the most (Cook, 2001). START classifies the injured into two major categories: those who need medical treatment immediately and those whose treatment can be delayed. When employing START, which is illustrated in Figure 1, a paramedic sequentially checks up to five diagnostic cues to decide which category a person falls into; a decision can be made after each cue is checked. In essence, START is a decision tree with a very simple structure. Using this type of tree, a person does not need to search for, and integrate all, the relevant information to reach a decision; thus, a decision can be quickly made with little effort. Such fast and frugal trees are designed to help people make decisions in real settings, potentially achieving a high level of decision accuracy under the constraints of limited information, time, and resources.

In contrast to fast and frugal trees, many other decision strategies, such as signal de-

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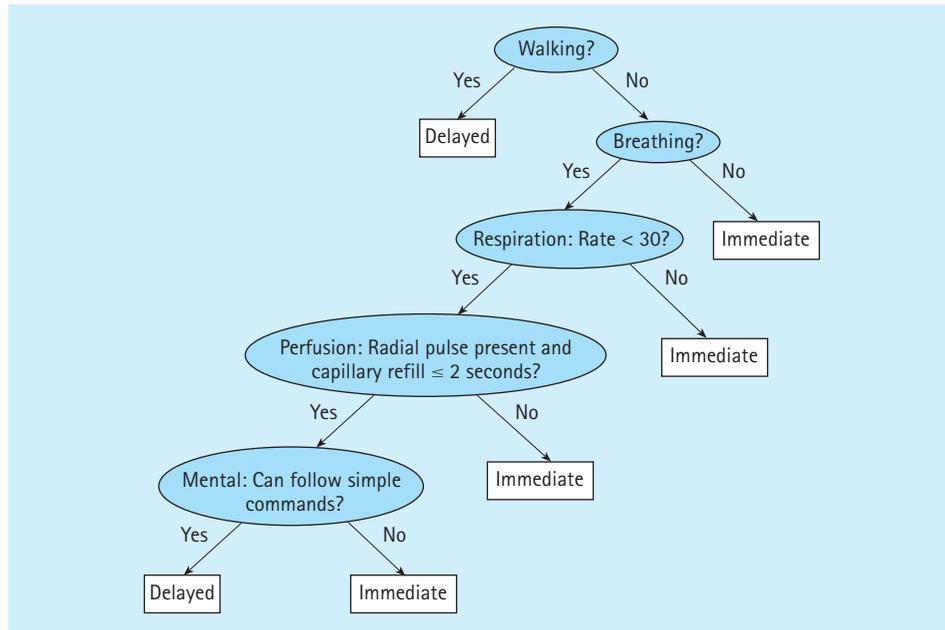


Figure 1. A fast and frugal tree used in the Simple Triage and Rapid Treatment (START) procedure, which categorizes patients into those who need immediate medical treatment and those whose treatment can be delayed (Super, 1984).

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tection theory, ignore such constraints. Originating from the statistical theory of Neyman-Pearson hypothesis testing, signal detection theory has been applied widely in psychology, starting with the study of perception and sensation. Arguably, signal detection theory's most important contribution is to characterize performance in terms of sensitivity and decision bias. For instance, the sensitivity of a smoke detector is how well the device measures smoke, and its decision bias is how much smoke must be in the air before the alarm is set to sound. A liberal alarm would be set to trigger at the slightest hint of smoke, so it would likely detect a fire when there is one (a hit), but, at the same time, it might be set off by burnt toast (a false alarm). By attempting an integration of signal detection theory with simple heuristics, Luan, Schooler, and Gigerenzer (in press) showed how the concepts of sensitivity and decision bias can be used to understand the workings of fast and frugal trees. For example, a tree's sensitivity is, in general, positively related to the sensitivities of the individual cues that compose the tree and affected little by the

decision biases of these cues. The principle of *lexicographic decision bias* can be used to determine which of two trees is more liberal: If two trees share cues that are ordered by the relative sensitivity of the individual cues, then the relative bias of the two trees can be compared simply by considering the bias of the top most cues that distinguish them. That is, cues lower down in the tree cannot override the bias of the cues considered earlier. In comparison to other models—including a sequential sampling model that tries to strike an optimal balance between the gains associated with having access to additional cue information and the costs of searching for that information—the fast and frugal trees compared well in terms of sensitivity and balancing these information gains and costs, especially at smaller sample sizes.

Forecasting Elections With the Recognition Heuristic

Every couple of years, German political parties and candidates invest millions of euros in advertisements, hoping to embed their names in the recognition memories of the elector-

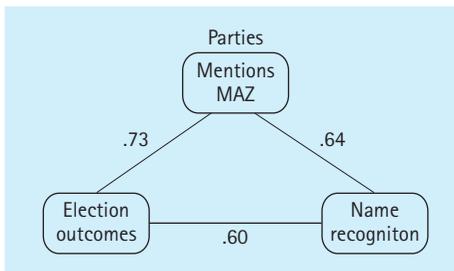


Figure 2. Recognition enables voters to forecast elections for 15 parties competing in the 2004 parliamentary election in the German federal state of Brandenburg. Shown are the gamma correlations computed between the number of mentions of the parties in the *Märkische Allgemeine* (MAZ) newspaper, the number of votes won by the parties, and proportion of eligible voters from Marewski et al. (2010) who recognized the name of a party.

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ate. They are betting that elevating name recognition increases the chances that the electorate will consider voting for them. At the same time, throughout Germany, people are wondering who will emerge from the elections as winners. In three German elections, Marewski, Gaissmaier, Schooler, Goldstein, and Gigerenzer (2010) examined various strategies that people might use to forecast the election outcomes. One such strategy is known as the *recognition heuristic* (Goldstein & Gigerenzer, 2002). According to this simple rule of thumb, inferences can be based solely on a sense of *recognition*, which depends on a chain of correlations. Parties that tend to be successful in elections tend to be mentioned more frequently in the media prior to the elections than those that are less successful. As a result, more successful parties are more likely to be recognized, enabling voters to rely on recognition to identify likely winners. Figure 2 illustrates these correlations for the 15 political parties competing in the 2004 parliamentary elections in the German federal state of Brandenburg.

In examining whether German voters use recognition to forecast election outcomes, Marewski et al. (2010) also addressed concerns about the heuristic's adequacy as a model of behavior: Past experiments have led several authors to conclude that there is little evidence that people base inferences on recognition alone, as assumed by the recognition

heuristic. Instead, they argue that recognition is integrated with other cues. In the context of forecasting political elections, such cues could be a candidate's party affiliation or knowledge about a party's political agenda. In past studies on the recognition heuristic, the competing hypothesis that recognition is integrated with other cues was never spelled out as a computational model. In their studies, Marewski et al. (2010) specified five competing models. In their model competitions, the recognition heuristic emerged as the best predictor of voters' election forecasts.

The Aging Decision Maker

The 21st century may become known as the century of centenarians: It has been argued by demographers that most babies born since 2000 in countries with long life expectancies, such as Germany or France, will likely live to be 100. Increasing life expectancy, among other factors, is leading to aging populations in such countries and forcing people to work longer and make important decisions about health and wealth very late in their lives. But how does age-related cognitive decline impact individuals' decision-making abilities? Mata, Schooler, and Rieskamp (2007) found that both younger and older adults were able to select simple and complex strategies adaptively, that is, choose the strategy that matches the task environment. Nevertheless, older adults showed a stronger tendency to use simpler strategies, even in an environment in which a more complex one would be more appropriate. These age differences in strategy use were mediated by age difference in fluid intelligence. Mata et al.'s (2007) results suggest that the aging decision maker adapts to losses in cognitive functioning by relying increasingly on simple strategies. Pachur, Mata, and Schooler (2009) extended this line of research to the use of recognition in decision making, comparing younger and older adults' adaptive use of recognition in different environments. These authors found that both younger and older adults relied more on recognition when its validity was high (compared to when it was low) but also that older adults showed a stronger tendency to use the recognition cue relative to younger

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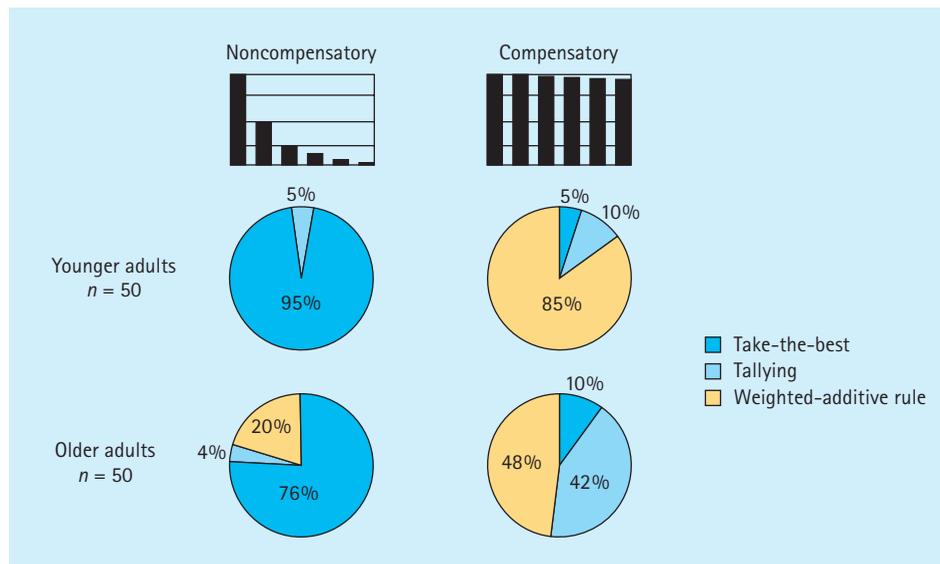


Figure 3. Older subjects learn to use strategies adaptively: Mata, von Helversen, and Rieskamp (2010) conducted an experiment in which the participants had to decide which of three company stocks would be more profitable. When making their inferences, participants were able to look up characteristics of each company (e.g., past revenue, shareholder ratings). In the compensatory environment, participants had to rely on all characteristics to infer which company would do best. In the noncompensatory environment, some characteristics were more predictive than others. Using a simple heuristic, take-the-best, would yield the higher payoff in the noncompensatory environment. The weighted-additive rule, which weights the attribute values based on how well they predict, would yield the higher payoff in the compensatory environment. Use of a third strategy, tallying, was also tested. Tallying simplifies the weighted-additive rule by assigning a unit weight (–1 or 1) to each cue. Participants were classified according to which decision strategy described their decisions best. As can be seen in the strategy classification results after an extensive learning period, the older participants had more difficulties adjusting to both environments on the basis of performance feedback compared to younger adults. However, while the majority of older adults were able to learn to select the take-the-best strategy in the noncompensatory environment, less than half were able to learn to select the more complex weighted-additive rule in the compensatory environment.

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adults, even when this led to a reduced inference accuracy.

Mata, von Helversen, and Rieskamp (2010) investigated the ability of younger and older adults to adapt their decision strategies as a function of environment structure when provided with performance feedback. They modeled choice behavior using a reinforcement learning model that assumes that participants adjust the value of strategies through reward-based learning. Their results showed that, while both younger and older adults were adaptive in choosing the strategy that matches the task environment, older adults showed poorer learning relative to younger adults, particularly in an environment favoring the use of a more cognitively demanding strategy, the weighted-additive rule, which requires extensive information integration (see Figure 3).

In sum, while both younger and older adults are adaptive decision makers, age-related decline may lead older adults to rely on simpler strategies to make decisions. Overall, these studies illustrate how changes over the life course can be investigated in terms of changes in the selection and application of strategies from the adaptive toolbox. Moreover, these represent an important attempt to identify environments that may require intervention to ensure successful decision making by the elderly.

Ecological Rationality

The accuracy of a decision-making strategy depends on the structure of the environment in which it is used. Understanding the adaptive relationship between properties of decision strategies and the structure of the environment is a key area of research within the ABC Research Group, and we investigate the ecological rationality of various decision strategies using methods such as computer simulation and mathematical analysis. The study of ecological rationality aims to formalize statements about the relative success of decision strategies for different environmental structures. Success is measured by external criteria, such as speed, frugality, and predictive accuracy rather than by internal criteria, such as logical consistency. The interplay between the organism and its environment is the fundamental unit of analysis in our research, and here we will present a sample of our recent findings.

Robust Ordinary Information

One of the major findings in the study of ecological rationality is that heuristics implementing limited information search and non-compensatory processing of information, such as take-the-best, can make more accurate inferences than computationally more complex models, such as classification and regression trees and neural networks. A noncompensatory decision strategy uses the first piece of information which allows a decision to be made and ignores all other factors. For example, a decision maker relying on the simple heuristic, take-the-best, might decide between which of two houses to buy using only a single cue, such as location. Findings such as these pose a challenge to the supposedly universal law of the effort-accuracy trade-off: If people invest more cognitive effort, such as considering more information, they achieve more accuracy in their choices and judgments. This challenge, however, has been criticized since heuristics, like more complex strategies, rely on underlying abilities which may themselves require complex computations. For example, take-the-best, like all lexicographic heuristics, relies on an ability to find a good ordering of cues before a decision can be made.

Katsikopoulos, Schooler, and Hertwig (2010) provided arguments and evidence against this criticism. First, they discussed ways for ordering cues, such as evolution, culture, and individual learning, which do not entail complex individual learning. Second, they argued that, when orders are learned individually, people's necessarily limited information will curtail computational complexity while also achieving higher accuracy. In a computer

simulation, Katsikopoulos et al. (2010) tested the accuracy of various decision-making models in 19 real-world problems, from domains such as biology, economics, and sociology. For example, one inference problem required the decision maker to decide which one of two cities (e.g., Chicago or Berkeley) has a higher homelessness rate. Here, one of two objects (cities) must be selected as having the higher criterion value (homelessness rate). The inference is made on the basis of pieces of information (e.g., "Is the city a state capital?"), called cues, which correlate, albeit imperfectly, with the criterion.

All decision strategies use cues to make inferences, but they tend to differ in how they process these cues. Some models are computationally complex in that they weight and add cues (linear regression) or make probabilistic computations (naïve Bayes), whereas other models, such as simple heuristics, may use only one cue (e.g., take-the-best) or add cues without weighing their values (e.g., tallying). The parameters estimated by the models may include the regression weights in case of linear regression, or cue validities and directions in the case of take-the-best. The validity of a cue is a simple measure of the correlation between the cue and the criterion, and the direction of a cue is the sign of this correlation. Table 1 summarizes the nine decision strategies investigated by Katsikopoulos et al. (2010).

To compare the accuracy of each of these models, each of the 19 data sets was split in two parts and the parameters of each model were estimated on one part, the *training set*. These parameter estimates were used, for

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Table 1
The Nine Decision Strategies Compared by Katsikopoulos et al. (2010)

Model	Decision strategy	Parameters
Multiple linear regression with dichotomized cues (MR_D)	Select object with higher weighted sum of cue values	Regression weights
Multiple linear regression with undichotomized cues (MR_U)	Select object with higher weighted sum of cue values	Regression weights
Naïve Bayes with dichotomized cues and frequentist validity (NB_F)	Select object with higher probability of having higher criterion value	Cue validities
Naïve Bayes with dichotomized cues and Bayesian validity (NB_B)	Select object with higher probability of having higher criterion value	Cue validities
Tallying with dichotomized cues (TAL)	Select object with higher sum of cue values	Cue directions
Minimalist with dichotomized cues (MIN)	Select object with higher value on random cue that discriminates	Cue directions
Take-the-best with dichotomized cues and frequentist validity (TTB_F)	Select object with higher value on most valid cue that discriminates	Order of cue validities
Take-the-best with dichotomized cues and Bayesian validity (TTB_B)	Select object with higher value on most valid cue that discriminates	Order of cue validities
Take-the-best with undichotomized cues and frequentist validity (TTB_U)	Select object with higher value on most valid cue that discriminates	Order of cue validities

Note. Each decision strategy (detailed in column 2) must estimate the parameters (given in column 3) from the available observations.

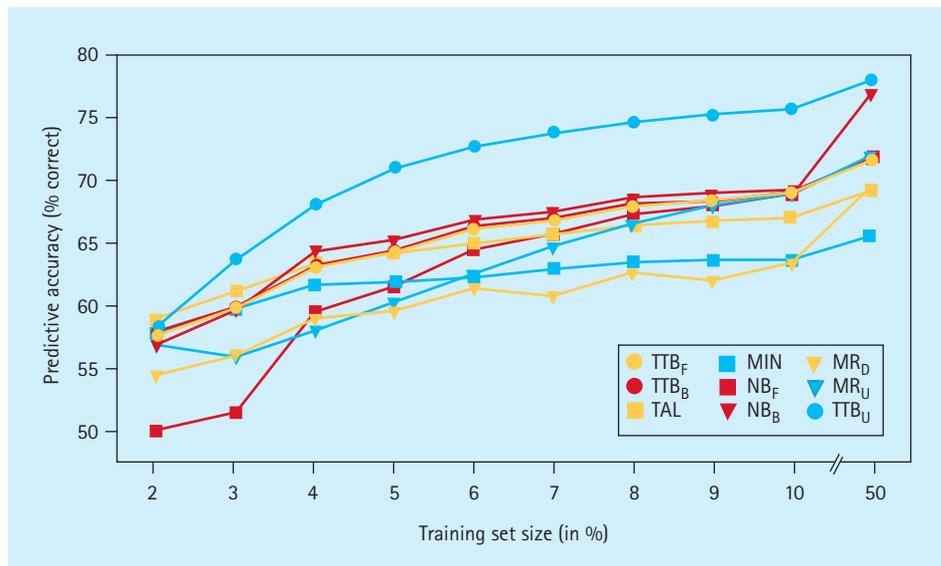


Figure 4. Mean predictive accuracy (across 19 environments) of fast and frugal heuristics and benchmark models as a function of the size of the training set. For small training samples, take-the-best with undichotomized cues is more accurate than the eight other heuristic and computationally complex models, such as naïve Bayes and linear regression. See Table 1 for a description of each model.

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each model, to make inferences on the other part, the *test set*. This process was repeated 1,000 times. Besides the usual training set size of 50% of the whole data set, the authors also tested minute training sets, from 2 to 10 objects (3% to 15% of the whole 19 data sets used), in order to simulate people's limited information. Model performance was assessed by measuring their predictive accuracy, which is the proportion of correct inferences they make on the test set. Figure 4 shows the average predictive accuracy of the models for all training set sizes.

As can be seen in Figure 4, models are differentially influenced by the information that small samples of 2 to 10 objects contain. The predictive accuracy of linear regression and naïve Bayes is compromised, presumably because training sets with 10 or fewer objects provide unreliable point estimates of regression weights and cue validities. The heuristics, in contrast, seem capable of making do with very limited information: Tallying excels when the training set contains only two objects, whereas take-the-best with undichotomized cues is the most accurate model for sets including between 3 and 10 objects, with a difference in accuracy of more than five percentage points on average.

Katsikopoulos et al. (2010) termed the information provided by small training samples "ordinary information." Another instance of ordinary information is laypeople's intuitions. Katsikopoulos et al. (2010) found that when heuristics, such as take-the-best and tallying, are fed with people's intuitions about cue directions and cue orders, they can match the predictive accuracy of the heuristics with a training sample of 50% of the whole data set. What is puzzling about the high accuracy of take-the-best with undichotomized cues was that take-the-best relies just on a single cue, the one with the highest validity estimate in the training sample. In the case of continuous cues, this cue will almost always discriminate between two objects. The solution to this puzzle remains unsolved, but a partial explanation can be found in the concepts of noncompensatory cue structure and the bias-variance dilemma. In an environment with a noncompensatory cue structure, the validity

of the most valid cue is much higher than the validities of the other cues, and this leads to take-the-best achieving maximum accuracy (Katsikopoulos & Martignon, 2006). However, this explanation does not consider the criterion of predictive accuracy, used above, neither does it consider the process of sampling which is critical to take-the-best's success. In related work, Gigerenzer and Brighton (2009) took into account these factors and argued that heuristics achieve high predictive accuracy because their comparatively low variance compensates for their comparatively high bias. Reconciling these two perspectives on understanding the ecological rationality of heuristics is a current topic of research within the group.

Small and Large Worlds

A number of studies have investigated the ecological rationality of a diverse set of decision strategies, making it necessary to consolidate and review this literature with a view to identifying common underlying principles. For example, there have been syntheses of the available results for psychologists (Gigerenzer & Gaissmaier, 2011), and management scientists (Katsikopoulos, 2011). Gigerenzer and Gaissmaier (2011) emphasize the concept of large worlds where "... part of the relevant information is unknown or has to be estimated from small samples." Gigerenzer and Gaissmaier claim that the optimization models typically developed in economics, operations research, and management science may often fail in large worlds. This could be because in large worlds (a) the mathematical assumptions (e.g., linearity or normality) of optimization models may not be a good approximation to reality, and (b) the available data may not be of sufficiently high quality for estimating model parameters reliably. On the other hand, simple models, such as heuristics that rely on fewer parameters, are less sensitive to violations of these two conditions. In sum, in large worlds, it is an open question whether optimization models or heuristics perform better. In fact, we saw above that heuristics outperformed optimization models in a large world where information about cues was ordinary.

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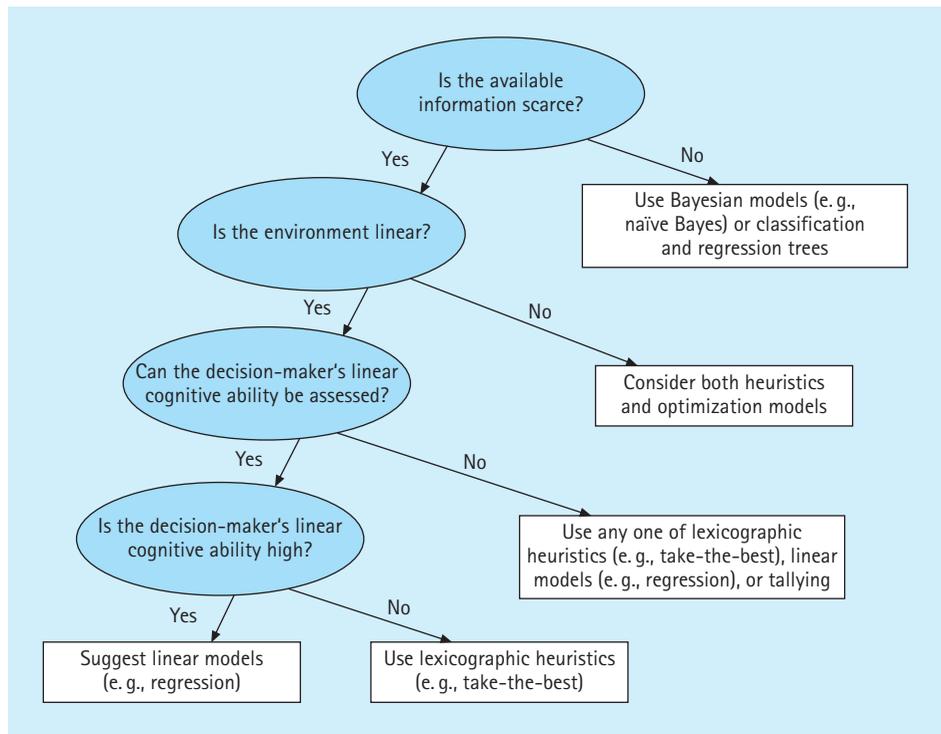


Figure 5. A fast and frugal decision tree used to guide the process of deciding which general approach to decision making is likely to prove effective. Three characteristics of the task environment are (potentially) considered: the scarcity of information, the linearity of the environment, the decision-maker's linear cognitive ability (Katsikopoulos, 2010a).

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Katsikopoulos (in press) collected empirical and theoretical results that compare heuristics and optimization models and proposed the tree shown in Figure 5 for deciding which model to use, depending on the characteristics of the decision problem. In Figure 5, scarce information is an instance of information in a large world. For example, there may be only a few decision options or few attributes for each decision option. Another environmental characteristic is linearity, where the criterion value, or utility, of a decision option is a linear function of its attribute values. The linear cognitive ability of a decision maker is a measure of how well the decision maker applies a linear model in a linear environment.

Less Can Be More

Above, we considered under which conditions lexicographic heuristics, such as take-the-best, are successful. Next, we focus

on an even simpler heuristic. Recall the inference problem discussed earlier: Which of Chicago or Berkeley has a higher homelessness rate? If you recognize Chicago but not Berkeley, you may infer that Chicago has a higher homelessness rate, and this would be consistent with using the recognition heuristic:

"In an inference problem, if you recognize one object and not the other, infer that the recognized object has a higher criterion value." There has been more than 10 years of research on the recognition heuristic; Marewski, Pohl, and Vitouch (2010) edited two special issues of relevant research in *Judgment and Decision Making* (see Box 2). A key question is, under which conditions can the use of the recognition heuristic result in the *less-is-more effect*. This counterintuitive effect refers to how experiencing fewer objects lead the decision maker to make decision with greater accuracy.

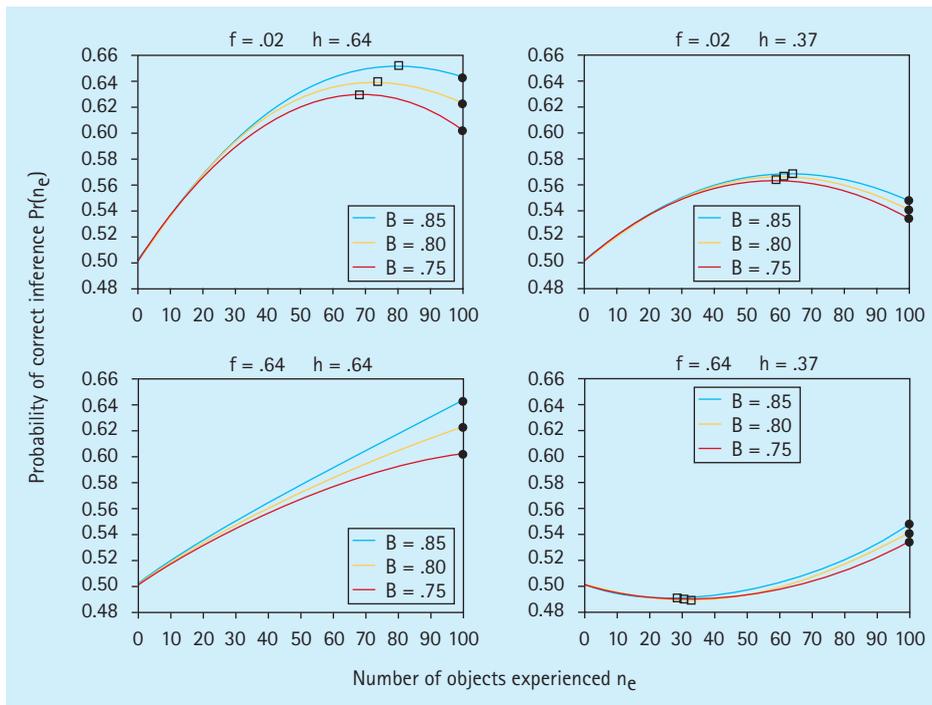


Figure 6. When are less-is-more effects likely to hold? Heuristic accuracy was fixed at .8, while knowledge accuracy B was set to either .75, .8, or .85. The four panels refer to four combinations of high and low values of hits (h) and false alarms (f). As can be seen in the two upper panels, if the false-alarm rate is low, less-is-more effects can occur even if heuristic accuracy is smaller than knowledge accuracy. Conversely, if the false-alarm rate is high, less-is-more effects may be absent.

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Until recently, it was believed (Pleskac, 2007) that a necessary condition for the less-is-more effect is that the accuracy of the recognition heuristic is larger than the accuracy of strategies relying on further knowledge, where knowledge is a blanket term for any inference model that can be used except the recognition heuristic and pure guessing. Katsikopoulos (2010b), however, analytically showed that the less-is-more effect is also

possible if heuristic accuracy is lower or equal to the accuracy of knowledge.

The inverted U-shape curves in the top two panels of Figure 6 illustrate that, when the false-alarm rate is low, a less-is-more effect can occur even though the accuracy of recognition knowledge is lower than other forms of knowledge. The bottom two panels show that, when the false-alarm rate is high, less-is-more effects are less likely.

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Social and Evolutionary Rationality

We live in a social world. Most other animals do too. The social world affords many opportunities and challenges for decision making, from the benefits of collective cognition and cooperation to the costs of groupthink and cut-throat competition. Some social situations appear, at least at the moment, to be uniquely human. For instance, morality in humans has been studied for millennia, with dozens of viewpoints on what behavior is morally permissible. But do morally relevant situations always require special sophisticated decision-making processes, or can simple heuristics play a role in moral behavior?

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Other social situations are not uniquely human, but are faced by a number of animal species. An evolutionary perspective can be useful here because it provides two advantages. First, it offers the ability to test hypotheses across different species that differ in their natural ecology. Thus, we can investigate ecological rationality with a potentially broad range of environments experienced by different species. Second, an evolutionary view can offer a theoretical framework for thinking about the adaptive nature of decision making. Here, we explore how the study of heuristics and the core capacities underlying them are relevant to social decision making in humans and other animals by assessing the adaptive benefits of group decision making and cooperation.

Moral Satisficing

Every year, an estimated 1,000 Germans die waiting in vain for a suitable organ donor. Only 12% of Germans have consented to donating their organs upon their death. Other countries, such as the United Kingdom and the United States, show only slightly higher levels of consent, 17% and 28%, respectively. In contrast, Austria, France, Hungary, Poland, and Portugal all have consent rates exceeding 99% (see Figure 7). Why do we see such differences in organ donation across these countries? Whether to donate one's organs is a moral decision that we all face. How do we make decisions in these types of morally relevant situations? There are at least three primary perspectives. In the utilitarian view, the morally permissible action is the one that maximizes the overall utility of all individu-

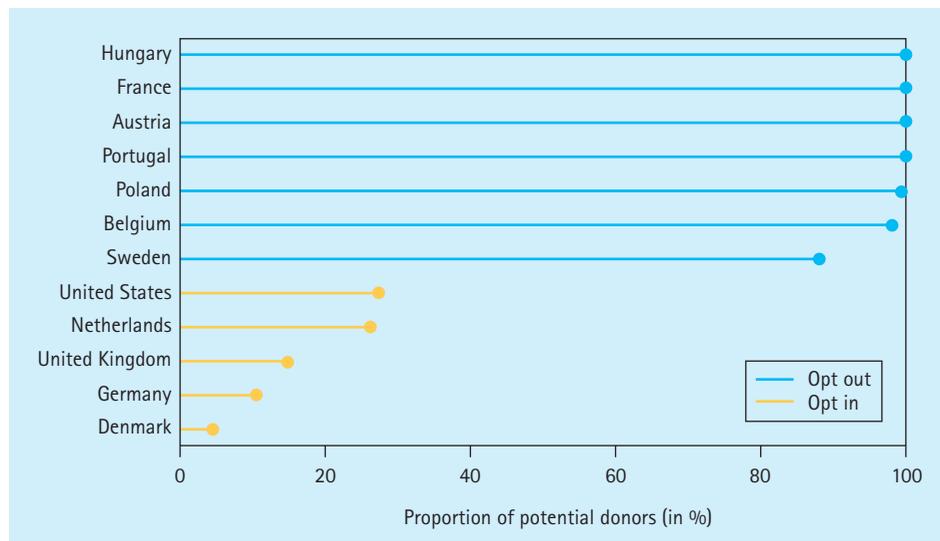


Figure 7. Countries differ dramatically in the proportion of potential organ donors. The clear disparity in consent rate is attributable to majority use of the default heuristic, and the countries' policy regarding whether residents must opt in to give consent or opt out of assumed consent (Johnson & Goldstein, 2003).

Source. Based on the figure of Gigerenzer (2010c) and Johnson & Goldstein (2003).

als involved, accounting for the costs and benefits of the potential outcomes. A virtue perspective, in contrast, highlights the moral character of individuals. Finally, the deontological perspective emphasizes the following of moral rules. Similarly, following commandments and other socially transmitted rules can govern moral behavior.

Gigerenzer (2010c) argues that there exists another possible mechanism underlying our behavior in morally relevant situations: heuristics. In some of these situations, we may exhibit consistent character traits, trade off the good and the bad of our actions, or follow the dictate of a moral rule or commandment. But in many cases, we may simply use a heuristic in morally relevant situations. Take the organ donor shortage (Johnson & Goldstein, 2003). Is it possible that a heuristic could account for the extreme differences in consent rates between countries? Rather than making sweeping claims about the moral character of residents of these countries, Gigerenzer (2010c) suggests that most people use the same default heuristic: If there is a default, do nothing about it. What differs across these countries is not moral character or commandments, but the government-imposed default for making an organ donation choice. In Germany, the United Kingdom, and the United States, individuals must actively opt in to consenting to donate their organs. In the other countries, the default is giving consent to donate, and individuals must opt out. Thus, a simple heuristic has potentially life-saving implications in the moral domain of organ donation.

In addition to the default heuristic, other heuristics are used in moral situations. Imitation heuristics are particularly relevant. In particular, *imitate-your-peers* is a powerful heuristic that ignites jealousy and propagates fads worldwide. It also applies to moral situations, enhancing donations to charity yet amplifying discrimination toward minorities. *Imitate-the-successful* and *follow-the-leader* are further examples of imitation-based heuristics that we use frequently in moral situations. The *equality heuristic* involves dividing a resource equally among all possibilities. Though proposed as a means to allocate in-

vestments over assets in a financial portfolio, this heuristic may be relevant to parents dividing their love, time, and attention among their children (Hertwig, Davis, & Sulloway, 2002). An even split tends to foster coherence in a group by generating a sense of fairness and justice. Finally, *tit-for-tat* is a heuristic of helping someone who helped you last time (and withholding help if he or she withheld it last time). In his 1984 book on *The Evolution of Cooperation*, Axelrod describes how tit-for-tat is used in the morally charged domain of warfare: a system of "live and let live" for the soldiers in the trenches during World War I. If the soldiers attacked their opponents' supply lines, the opponents would reciprocate in turn. Therefore, a system of mutual restraint developed, allowing both sides to have access to their food and supplies. Implicit ceasefire agreements would even result in night patrols openly walking in front of the trenches, exposed to their enemy. Nevertheless, a single shot from the enemy would unleash a barrage of retaliatory fire. The military command put a stop to this tit-for-tat-like response. The heuristics we rely on may not be moral heuristics, but more general heuristics that are applied to morally relevant situations as well. The default heuristic applies not only to organ donation consent but also to environmental or "green" defaults (Pichert & Katsikopoulos, 2008), purchasing insurance, and choosing retirement plans. The equality heuristic is termed $1/N$ when used as a method for distributing investments and may explain distributions in the Dictator Game (Keller, Gummerum, Canz, Gigerenzer, & Takezawa, in press). Thus, these heuristics work well in nonmoral situations and may often be applied in morally relevant situations as well. The critical role of the environment is vital to understanding the heuristics discussed here. Like ecological rationality, the concept of *ecological morality* proposes that moral behavior results from the interaction between the mind's mechanisms and the environment. The organ donation case exemplifies this interaction. The striking difference in organ donation consent rates across countries can be attributed to using the same heuristic in different environments. When the default is

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consent, few people opt out. When the default is no consent, only a small percentage of people actively override that default (Johnson & Goldstein, 2003). This concept of ecological morality highlights the chance to engineer our environments to better reach our moral goals. If higher organ donation consent rates will help save lives, then changing the default may improve actual donation rates better and more cheaply than marketing campaigns. In summary, morally neutral heuristics may account for our behavior in many morally relevant situations. These heuristics depend on the environment, which gives us the opportunity to construct appropriate environments and shape the nature of decision making in the moral domain.

When to "Follow an Expert" and "Aggregate Information"

When confronted with a problem, social interaction can provide a solution that is not available to individuals. Two potential group decision-making mechanisms can yield solutions: (a) individuals can aggregate information across a group, thereby harnessing "collective cognition," or (b) individuals can follow specific "leaders," those experts with information particularly relevant to the decision at hand. A classic example of such social interaction involves a group of individuals deciding when to move toward a specific resource, such as foraging site or waterhole (Figure 8), or when to switch behavior (e.g.,

from resting to foraging). Biologists are now beginning to comprehend more fully the heuristics (which they refer to as *rules of thumb*) individuals use to make such social decisions. They find that individuals can exploit a higher order collective computational capability. Group members may come to a consensus not only about where to travel but also about what heuristics to use. Thus, groups may adapt to compute "the right thing" in different contexts, matching their collective information strategy with the statistical properties of their environment. This perspective lies at the heart of many research projects undertaken by the ABC Research Group. Importantly for the study of social decision making, ecological rationality emphasizes the importance of the social environment (Stevens & King, in press).

Katsikopoulos and King (2010) modeled the process of groups of individuals matching their collective information strategy with the statistical properties of their environment. They began by considering a hypothetical situation in which individuals have to choose between two options. In this situation, there is a correct choice for all individuals, and the level of information ("accuracy") varies across individuals and is sampled from a normal distribution. This is likely to be representative of a variety of choices faced by social animals (e.g., the presence or absence of a food resource or a predator). The model predicts that, when individuals favor the incorrect



Figure 8. A troop of baboons exhibit leader-follower behavior in the Namib Desert, Namibia.

© Zoological Society of London Tsaobis Baboon Project.

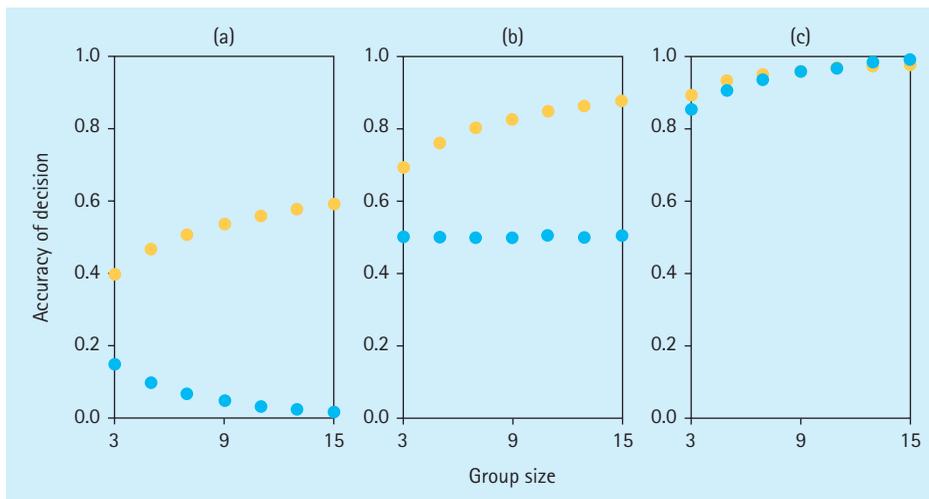


Figure 9. When should a group rely on a single individual to make a decision rather than aggregating the decisions of its members? The accuracy of decisions using an aggregated rule (blue circles) and an expert rule (orange circles) will depend on the group size. The three plots examine the effect of mean individual probability of choosing the correct option, m , and the standard deviation, s . From left to right, $m = .1, s = m/1.96$; $m = .5, s = m/1.96$; $m = .9, s = m/1.96$. For all but groups composed of highly informed individuals, relying on a single expert leads to greater accuracy.

Source: Katsikopoulos & King (2010).

option (are misinformed) or are equally likely to choose between options (have very little information), groups should adopt the choice of a single expert, especially in larger groups (Figure 9). However, if individuals are informed, then the collective is equal in accuracy to the expert in aggregating information. In these situations, *follow-the-leader* or the policy of aggregating information would work equally well.

Katsikopoulos and King (2010), however, acknowledged that this model, although applicable to one-shot decisions, might not represent what goes on in more stable social groups, in which individuals encounter repeated collective decisions and can store and recall information. They therefore used a Bayesian model to predict the probability of groups using expert and aggregate rules across time, based on the outcome of past decisions. In this form of the model, the rule that aggregates information is always favored, unless the first decision that a group makes is correct with high probability, in which case groups marginally favor the expert rule.

How might a group choose between these two decision rules? King, Johnson, and Van

Vugt (2009) discussed this issue in a recent review. On the one hand, the group-level heuristic can emerge passively as a consequence of the properties of the group. Otherwise, individuals can be more likely to follow certain "types" of individuals and thus be more likely to copy their actions. King et al. (2009) argue that, across species, individuals are more likely to emerge as leaders if they have particular morphological, physiological, or behavioral traits increasing their propensity to act first in coordination problems, and if they have superior knowledge.

King et al.'s (2009) review suggests that leadership shares common properties across humans and other animals, pointing to ancient roots and evolutionary origins. They suggest that identifying the origins of human leadership, as well as which aspects are shared with other animals and which are unique, offers ways of understanding, predicting, and improving leadership today. One of the most striking claims that King et al. make in their search for the evolutionary origins of leadership is that the same simple heuristics may underlie coordination of activities in humans and nonhumans alike. There are evolved

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rules of thumb that prescribe who to follow and when to follow them that have a deep evolutionary history. Thus, the mechanisms of group decision making are broadly adaptive, shaping social interactions across a broad range of species, including humans.

Memory Constraints on Cooperative Heuristics

Imagine that once a month you meet a colleague for lunch at an upscale restaurant. This month, your colleague pays for lunch. What should you do next month? And the following month? Should you pay for lunch, let your colleague pay again, or split the bill? A simple heuristic that one might use in this situation is *tit-for-tat*, which starts by cooperating and then copies a partner's previous action. This "you scratch my back, I'll scratch yours" heuristic has been successful in evolutionary and economic analyses of cooperative behavior. In fact, it has become the most studied solution to the problem of cooperation. Despite

its popularity and apparent simplicity, few studies have explored the cognitive capacities required to implement tit-for-tat and similar heuristics.

Memory represents a primary cognitive capacity needed for heuristics like tit-for-tat that depend on past behavior. Tit-for-tat requires that players accurately remember the single last choice from each partner. Humans and other animals, however, sometimes forget. Given the nature of forgetting, Stevens, Volstorf, Schooler, and Rieskamp (2011) asked whether existing heuristics that promote cooperation (such as tit-for-tat and its variants) are cognitively feasible. They explored whether humans have the memory capacity required to implement these strategies. To address this capacity question, they conducted an experiment with human participants, in which a series of simulated partners chose to cooperate or defect. They measured participants' memory accuracy in recalling each partner's last action. To test the effects of

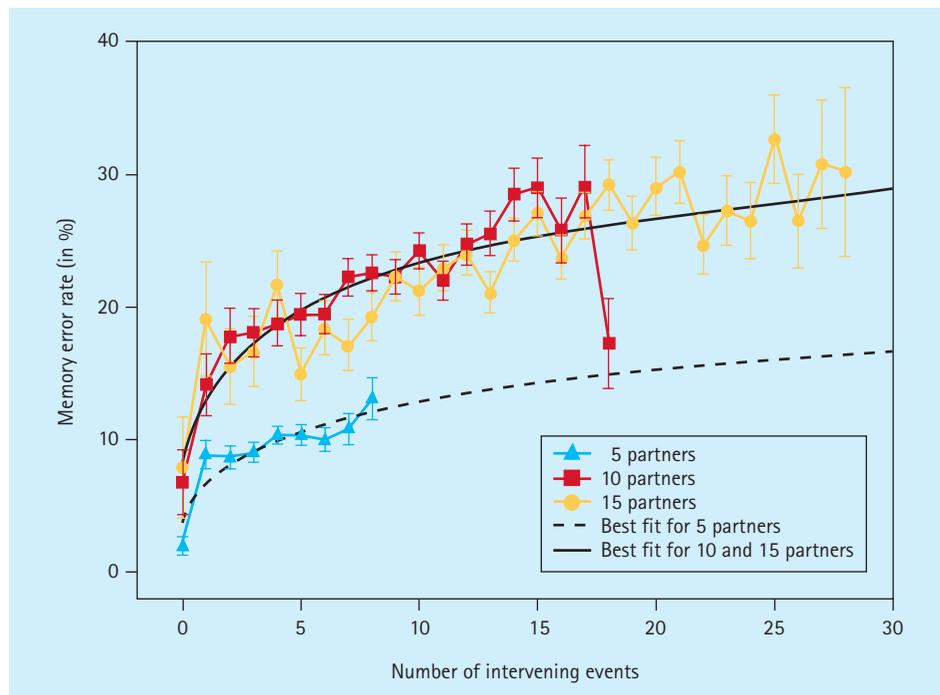


Figure 10. Can humans recall interactions with their partners well enough to accurately employ the tit-for-tat strategy? Memory error rate for this task (mean \pm SEM) increases with more intervening interactions. The smooth lines represent the least-squares best-fit power function of memory. With no intervening interactions, error rates were lower than 10%. Error rate increases rapidly with just a single intervening interaction.

Source. Stevens et al. (2011).

memory interference on cooperation, they varied the number of simulated interaction partners. From these manipulations, they estimated how memory errors respond to increases in memory interference. In this study, participants performed fairly accurately when tracking only 5 partners, but, with 10 or more partners, memory errors increased dramatically. In fact, the error rates in the 10- and 15-partner conditions suggest that participants were guessing in half of the trials. Thus, memory interference from tracking multiple partners sharply increased memory errors in this task. To further explore this memory interference, Stevens et al. (2011) examined error as a function of the number of intervening interactions. Between consecutive presentations of the same partner, there were other intervening partners. When consecutive interactions with the same partner occurred with no intervening interactions, participants performed well, with a mean error rate below

10% (Figure 10). With even one intervening interaction, however, error rates doubled and continued to rise with more intervening interactions.

Estimates of memory accuracy alone, however, do not demonstrate the complete role of memory in cooperation. We must also assess how well specific heuristics cope with error caused by misremembering a partner's last actions. For instance, tit-for-tat's performance decreases when errors exist because of mistakenly defecting results in the lower payoffs of mutual defection. A more forgiving form of tit-for-tat called contrite tit-for-tat performs better when individuals make errors. Stevens et al. (2011) used agent-based simulations to systematically analyze the success of several heuristics proposed in the literature across a broader range of error rates.

Figure 11 shows, that at low error rates, GRIM—a heuristic that begins by cooperating, then permanently switches to defection

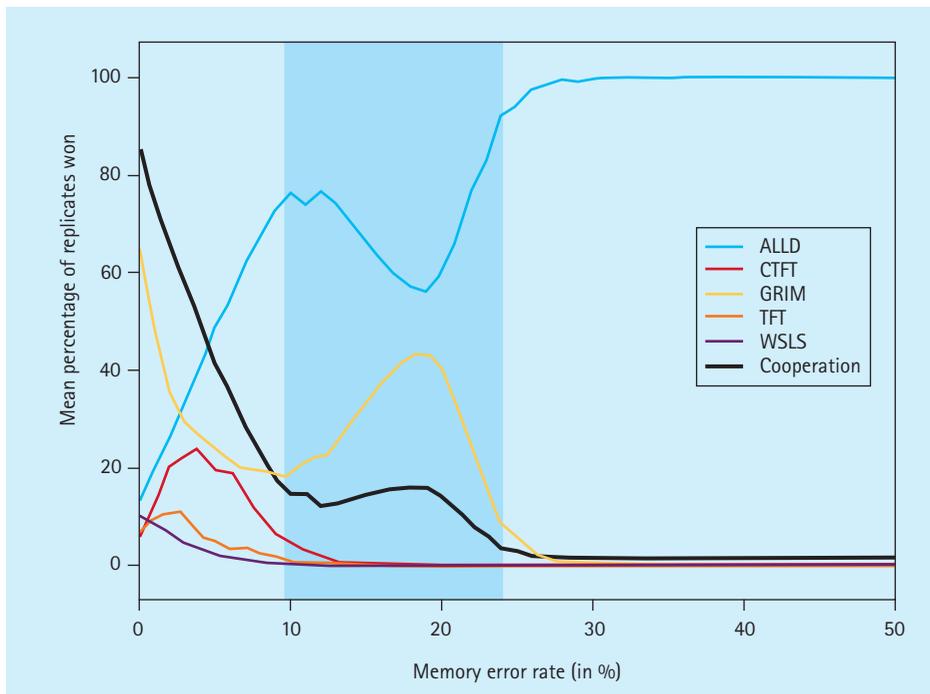


Figure 11. How do high error rates impact on the success of game-theoretic heuristics? This evolutionary simulation shows that, at low error rates, heuristic strategies GRIM, CTFT, TFT, WSLS, and ALLD persist. At the higher, experimentally observed, error rates (the shaded region), ALLD and GRIM outperform the other strategies. The proportion of cooperative choices made by all agents in the last generation decreases rapidly with increasing error rate.

Source. Stevens et al. (2011).

following the partner's first defection—outperformed all other heuristics. Tit-for-tat (TFT), contrite tit-for-tat (CTFT), and win-stay, lose-shift (WSLS) won a small percentage of the simulations, along with always defecting (ALLD). As error rates increased, ALLD and GRIM outcompeted TFT and the other cooperative heuristics. The poor performance of the cooperative heuristics resulted in the frequency of cooperative acts, employed by all agents in the population, decreasing dramatically as errors became more prevalent. Cooperation could not be sustained, even at low levels of error.

In summary, this study found that people make many mistakes when recalling past behavior. In addition, heuristics that require this kind of memory did not perform well in

an evolutionary simulation when faced with the error rates observed in the experiment. Though these models have proven valuable in investigating cooperation for the last 30 years, they do not accurately reflect underlying cognition. Humans certainly use reciprocal strategies when cooperating, but they likely do not use strategies like tit-for-tat and its relatives. They simply cannot use these heuristics because the memory load is too great. To examine the types of reciprocal strategies that humans and other animals use, we must embed what we know about memory into new realistic cooperative strategies. Building psychology into these models is a crucial next step in better understanding the nature of cooperation.

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. In this section, we report on a selected sample of our work outside the laboratory, focusing on physicians' and patients' health literacy, numeracy and graph literacy, defensive decision making, and consumer choice. Risk literacy in health is one of the most important and neglected cognitive competencies in modern society. Our group continues to play a pioneering role in improving the public understanding of risk, with 2009 seeing the official opening of the Harding Center for Risk Literacy (see Box 3). Also in 2009, Gerd Gigerenzer co-directed an Ernst Strüngmann Forum focusing on *Better doctors, better patients, better decisions: Envisioning health care 2020* (see Box 4).

2009 Marked the Opening of the Harding Center for Risk Literacy

April 23, 2009, marked the official opening of the Harding Center for Risk Literacy. The day was celebrated with speeches held by Barbara Bludau, General Secretary of the Max Planck Society; Gerd Gigerenzer; Ulman Lindenberger; and David Harding, Director of Winton Capital, who made the Harding Center possible with a generous fund and after whom the Center is named. Apart from pursuing basic research, an important goal of the Harding Center for Risk Literacy is increasing awareness of risk literacy and equipping the general public and experts with the tools and skills to deal with risks and uncertainties in a more informed way, particularly in the health domain.

To attain this goal, 50 keynotes, talks, and workshops were given by members of the Harding Center to the medical community in 2009/10, ranging from invited symposia at international conferences, such as the 5th International Shared Decision Making Conference in Boston (2009) or the World Health Summit in Berlin (2009 and 2010), to intensive training for physicians and medical students in Germany and abroad. In October 2009, Gerd Gigerenzer and Sir Muir Gray organized an Ernst Strüngmann Forum that brought together 40 international experts in Frankfurt to analyze systematically the issue of health illiteracy—a problem that affects both patients and health-care providers and hinders the delivery of quality health care.

The Harding Center's work was prominently covered in editorials of the major international medical journals (Archives of Internal Medicine, British Medical Journal, Bulletin of the World Health Organization, Maturitas) as well as in an opinion piece in Nature (October 29, 2009). Additionally, the Harding Center publishes methods for understanding risks in journals that are regularly read by physicians, such as the leading journal of the German Medical Association, Deutsches Ärzteblatt, or in journals for the general public, such as Scientific American Mind in the United States and Gehirn Et Geist in Germany. Finally, the Harding Center publishes key information about health topics on their website, such as the drug fact boxes for breast and prostate cancer screening shown in Tables 2 and 3.

Researchers at the Harding Center partake in a wide range of collaborations with opinion leaders in the field, both on the national and international level. Recently, the Harding Center established a collaboration with neurologists, lead by Christoph Heesen at the University Medical Center Hamburg-Eppendorf, who investigate how to best inform patients with multiple sclerosis and implement their results for communicating with real patients. Together with Norbert Donner-Banzhoff from the University of Marburg, the Harding Center received a DFG grant to study actual decision making by general practitioners in their practices. In collaboration with Jay Schulkin at Georgetown University, Washington, DC, the Harding Center is currently developing a scale to assess the numerical skills of physicians. Last, but not least, an interdisciplinary cooperation was established with David Skopec from the Zurich University of the Arts to develop and test intuitive visualizations of medical information.



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www.harding-center.de

Box 3.

Key References

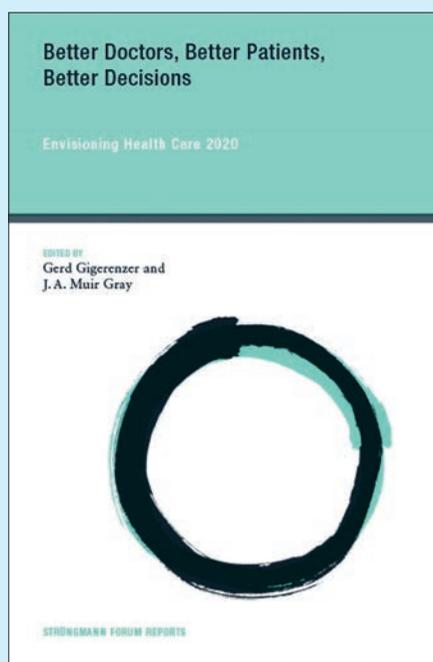
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In April 2011, The British Medical Journal will launch the book *Better doctors, better patients, better decisions: Envisioning health care in 2020*

Efficient health care requires informed doctors and patients. The health-care system we inherited from the 20th century falls short on both counts. Many doctors and most patients do not understand the available medical evidence. We identify seven "sins" that have contributed to this lack of knowledge: biased funding; biased reporting in medical journals, brochures, and the media; conflicts of interest; defensive medicine; and medical schools that fail to teach doctors how to comprehend health statistics. These flaws have generated a partially inefficient system that wastes taxpayers' money for unnecessary or even potentially harmful tests and treatments, and for medical research that is of limited relevance for the patient. Raising taxes or rationing care are often thought to be the only alternatives in the face of exploding health-care costs. Yet, there is a third option: through promoting health literacy, getting better care for less money. The 21st century should become the century of the patient. Governments and health institutions need to change course and provide honest and transparent information, creating better doctors, better patients, and, ultimately, better health care.

Better doctors (Gigerenzer & Gray, in press-a) is based on an Ernst Strüngmann Forum in October 2009, which brought together 40 medical researchers, presidents of medical associations, editors of medical journals, health journalists, psychologists, and representatives from health organizations, health industries, and health insurances from eight countries.



Box 4.

Public Knowledge of Benefits of Breast and Prostate Cancer Screening in Europe

Women and men in countries with modern health systems are confronted with the question of whether or not to participate in screening for breast and prostate cancer. Because screening can lead to harms, such as overtreatment, citizens need to understand the potential benefits of these screening programs before they can make informed decisions about participating. The current knowledge about the benefits and harms of mammography and PSA screening is summarized in Tables 2 and 3. Gigerenzer, Mata, and Frank (2009) carried out the first European-wide assessment of citizens' knowledge of the cancer-specific mortality reduction (as opposed to the total cancer mortality reduction, which is equally important, but rarely communicated to the public). For mammography screening, this reduction is in the order of 1 in 1,000 (Table 2) and for PSA screening between 0 and 1 in 1,000 (Table 3). Note that

these benefits are often communicated to the public in terms of more impressive relative risks, such as a "20% risk reduction" (e.g., from 5 to 4 in 1,000).

The study included nine European countries (Austria, France, Germany, Italy, Netherlands, Poland, Russia, Spain, and the United Kingdom). Face-to-face computer-assisted personal interviews were conducted with 10,228 persons selected by a representative quota method based on the official statistics concerning five variables: region, size of household, sex, profession, and age. Women were asked:

"1,000 women aged 40 and older from the general population participate every 2 years in screening for breast cancer with mammography. After 10 years, the benefit is measured. Please estimate how many fewer women die from breast cancer in the group who participate in screening compared to women who do not participate in screening."

Men were asked a corresponding question about PSA screening. Participants were also

queried on the extent to which they consulted 14 different sources of health information. The percentage of women who have had mammography is 57 in Germany, 78 in France, 76 in Austria, 85 in the Netherlands, 66 in Italy, 75 in the United Kingdom, 52 in Spain, 47 in Poland, and 19 in Russia. Ninety-two percent of women overestimated the mortality reduction from mammography screening by at least one order of magnitude or reported that they did not know (Table 4). For instance, in the United Kingdom, about 27% of women assumed a reduction of “200 in 1,000,” possible due to their understanding of the popular “20% risk reduction” message. Eighty-nine percent of men overestimated the benefits of PSA screening by a similar extent or did not know (Table 5). The country in which men and women showed the least overestimation of the benefit of screening was Russia—not because Russians were better informed, but possibly because they were less misinformed. Women and men aged 50 to 69, and, thus, targeted by screening programs, overestimated the benefits of mammography and PSA screening more than the general public. Citizens who searched frequently for health information on the Internet, TV, or in print media had no better understanding than those who did not. None of the 14 information sources, apart from health-insurance brochures, was associated with lower overestimation of the benefits. However, frequent consulting of physicians and health pamphlets tended to increase rather than decrease overestimation. In sum, the vast majority of citizens in nine European countries systematically overestimate the benefits of mammography and PSA screening. In the countries investigated, physicians and other information sources appear to have little impact on improving citizens' perceptions of these benefits. One of the reasons why the public is systematically misinformed may be that many doctors do not know the scientific evidence either, and that many health brochures appear to pursue the goal of increasing participation rates (rather than of informing patients) and overstate the benefits while downplaying the harms. Whatever the causes, this study documents

that information about the actual benefits of screening has not reached the general public. As a consequence, preconditions for informed medical decision making are not met in Europe, despite several governments' call for a 21st century of health care with informed patients.



Table 2
Transparent Fact Box Explaining the Benefits and Harms of Early Detection of Breast Cancer by Mammography

<i>Breast cancer screening with mammography: per 1,000 women 50+</i>		
	No screening	Yearly screening over 10 years
<i>Benefits?</i>		
Total cancer mortality	26	26
Breast cancer specific mortality	5	4
<i>Risks?</i>		
False positives with biopsies	–	50–200
Unnecessary treatments (e. g., lumpectomy)	–	2–10

Source. Götzsche, P. C., & Nielsen, M. (2006). Screening for breast cancer with mammography. *Cochrane Database of Systematic Reviews*, 4:CD001877. Woloshin, S., & Schwartz, L. M. (2009). Numbers needed to decide. *Journal of the National Cancer Institute*, 101(17), 1163–1165. doi: 10.1093/jnci/djp263



Table 3
Transparent Fact Box Explaining the Benefits and Harms of Prostate-Specific Antigen (PSA) Tests

<i>Prostate cancer screening with PSA test: per 1,000 men 55+</i>		
	No screening	Screening over 9 years
<i>Benefits?</i>		
Total cancer mortality	23.8	23.9
Prostate cancer specific mortality in the USA	2.3	2.3
Prostate cancer specific mortality in Europe	3.7	3.0
<i>Risks?</i>		
False positives with biopsies	–	50–200
Unnecessary treatments (e. g., prostatectomy)	–	10–30

Source. Andriole, G. L., Grubb, R. L., Buys, S. S., et al. (2009). Mortality results from a randomized prostate cancer screening trial. *New England Journal of Medicine*, 360(3), 1310–1319. Schröder, F. H., Hugosson, J., Roobol, M. J., et al. (2009). Screening and prostate-cancer mortality in a randomized European study. *New England Journal of Medicine*, 360(13), 1320–1328. Woloshin, S., & Schwartz, L. M. (2009). Numbers needed to decide. *Journal of the National Cancer Institute*, 101(17), 1163–1165. doi: 10.1093/jnci/djp263

Table 4
 How Well Informed Are Women of the Benefits of Mammography Screening? Perceived Reduction of Breast Cancer Mortality Through Regular Participation in Mammography Screening. Question: "How Many Fewer Women Die From Breast Cancer in the Group Who Participate in Screening, Compared to Women Who Do Not Participate in Screening?" Best Correct Estimate is 1 in 1,000. Mean Across All Nine Countries is Weighted by Sample Size

<i>Reduction out of 1,000?</i>	<i>Percentage of responders</i>									
	<i>Mean</i>	<i>Germany</i>	<i>France</i>	<i>Austria</i>	<i>Netherlands</i>	<i>Italy</i>	<i>United Kingdom</i>	<i>Spain</i>	<i>Poland</i>	<i>Russia</i>
None	6.4	1.4	0.8	2.4	0.7	5.3	2.0	3.9	4.2	16.1
1	1.5	0.8	1.3	2.9	1.4	1.3	1.9	2.7	0.8	1.7
10	11.7	12.8	15.7	11.0	10.7	10.6	10.3	6.9	9.7	12.4
50	18.9	21.3	21.7	22.1	22.6	17.4	13.9	11.7	20.5	20.1
100	15.0	16.8	21.5	20.8	22.5	13.9	17.0	11.3	14.8	10.8
200	15.2	13.7	23.7	11.0	20.1	15.2	26.9	15.7	17.1	6.8
Don't know	31.4	33.1	15.3	29.8	22.1	36.3	28.0	48.0	32.9	32.1

Table 5
 How Well Informed Are Men of the Benefits of Prostate Cancer Screening? Perceived Reduction of Prostate Cancer Mortality Through Regular Participation in PSA Screening. Question: "How Many Fewer Men Die From Prostate Cancer in the Group Who Participate in Screening, Compared to Men Who Do Not Participate in Screening?" Best Correct Estimate is 0 or 1 in 1,000. Mean Across All Nine Countries is Weighted by Sample Size

<i>Reduction out of 1,000?</i>	<i>Percentage of responders</i>									
	<i>Mean</i>	<i>Germany</i>	<i>France</i>	<i>Austria</i>	<i>Netherlands</i>	<i>Italy</i>	<i>United Kingdom</i>	<i>Spain</i>	<i>Poland</i>	<i>Russia</i>
None	8.3	3.8	1.6	4.1	3.0	5.7	0.5	9.3	5.0	20.3
1	2.4	2.3	2.7	3.5	2.2	1.8	0.9	4.3	0.7	2.9
10	14.4	17.7	16.9	24.4	11.5	11.9	15.9	17.0	13.9	10.7
50	19.3	23.0	21.6	27.1	20.2	18.5	17.3	25.1	17.9	15.0
100	14.0	17.2	21.1	20.8	20.3	9.2	15.6	18.8	14.5	7.3
200	11.8	9.7	20.2	14.2	14.2	12.2	19.5	17.9	11.3	3.4
Don't know	29.8	26.3	15.9	5.9	28.5	40.6	30.2	7.6	36.7	40.4

Do Doctors Understand 5-Year Survival Rates?

Survival rates are perhaps the most common statistic used to report on the progress against cancer. Health brochures regularly inform that early detection of cancer results in high 5-year survival rates. Former New York City mayor Rudi Giuliani said in a 2007 campaign advertisement that survival rates for prostate cancer were 82% in the United States as opposed to 44% in England under "socialized medicine." A report by the UK Office for National Statistics noted that 5-year survival for colon cancer was 60% in the United States compared to 35% in Britain. Experts dubbed this gap "disgraceful" and former British Prime Minister Tony Blair set a target to increase survival rates by 20% over the next 10 years, saying that "We don't match other countries in its prevention, diagnosis, and treatment" (see Gigerenzer, Gaissmaier, Kurz-Milcke, Schwartz, & Woloshin, 2007, p. 58).

In fact, despite these large differences in survival rate, the *mortality rate* for colon and prostate cancer in Britain is about the same as the rate in the United States. Improvements in 5-year survival are usually touted as unambiguous signs of success. It might not be surprising that most people conclude from an increased survival an "extended life" or "delayed death." But, in the context of screening, this conclusion is wrong. Here, changes in survival rates have no relationship ($r = 0.0$) to changes in mortality for the 20 most common solid tumors in the United States (Welch, Schwartz, & Woloshin, 2000). Why is this?

This disassociation occurs because *survival rates* depend on the time the cancer is diagnosed, whereas *mortality rates* do not. A 5-year survival rate is defined as "the number of patients diagnosed with cancer still alive 5 years after diagnosis, divided by the number of patients diagnosed with cancer." To calculate a mortality rate, the time of diagnosis is ignored. Instead, the mortality rate is "the number of people who die from a certain cancer over a certain period, divided by the number of all people in the population." This difference makes the mortality rate, but not

the survival rate, resistant against two biases: *lead-time bias* and *overdiagnosis bias*. The term *lead-time bias* refers to the fact that screening moves forward the time of diagnosis, but may not move back the time of death (the $r = 0.0$ mentioned above). The term *overdiagnosis bias* refers to the fact that screening detects cell abnormalities that may meet the pathological definition of cancer, but never become clinically significant due to slow progress (so-called nonprogressive cancer). By definition, these patients will not die of that cancer within the next 5 years, but they are included in the numerator of the survival rate which inflates it. In contrast, mortality rates do not depend on these two biases and can actually measure whether screening can save lives. The differences in survival rates between the United States and the United Kingdom, for instance, are largely due to the fact that many more Americans participate in screening, not that more Americans live longer.

Physicians should know how to interpret survival and mortality rates in order to advise their patients properly. But do they? Wegwarth, Gaissmaier, and Gigerenzer (in press) tested 65 experienced German physicians specialized in internal medicine. Physicians were randomly allocated to one of two survival-rate settings: "group" and "time." In the "group" setting, data on a comparison between a screened and an unscreened group were given, while, in the "time" setting, data from between 1975 and 2004 were given. Each physician in each setting received four presentations of the same data:

- 5-year survival rates (5Y);
- 5-year survival and annual disease-specific mortality rates (5YM);
- annual disease-specific mortality (M);
- 5-year survival, annual disease-specific mortality, and incidence (5YMI).

Data were from the *Surveillance, Epidemiology and End Result* (SEER) program for prostate cancer (Ries et al., 2005). To mask the fact that these four presentations of data referred to the same cancer site (prostate), screenings and tumors were labeled with capital letters. Physicians were asked whether they would recommend the screening based on the information they had and whether they

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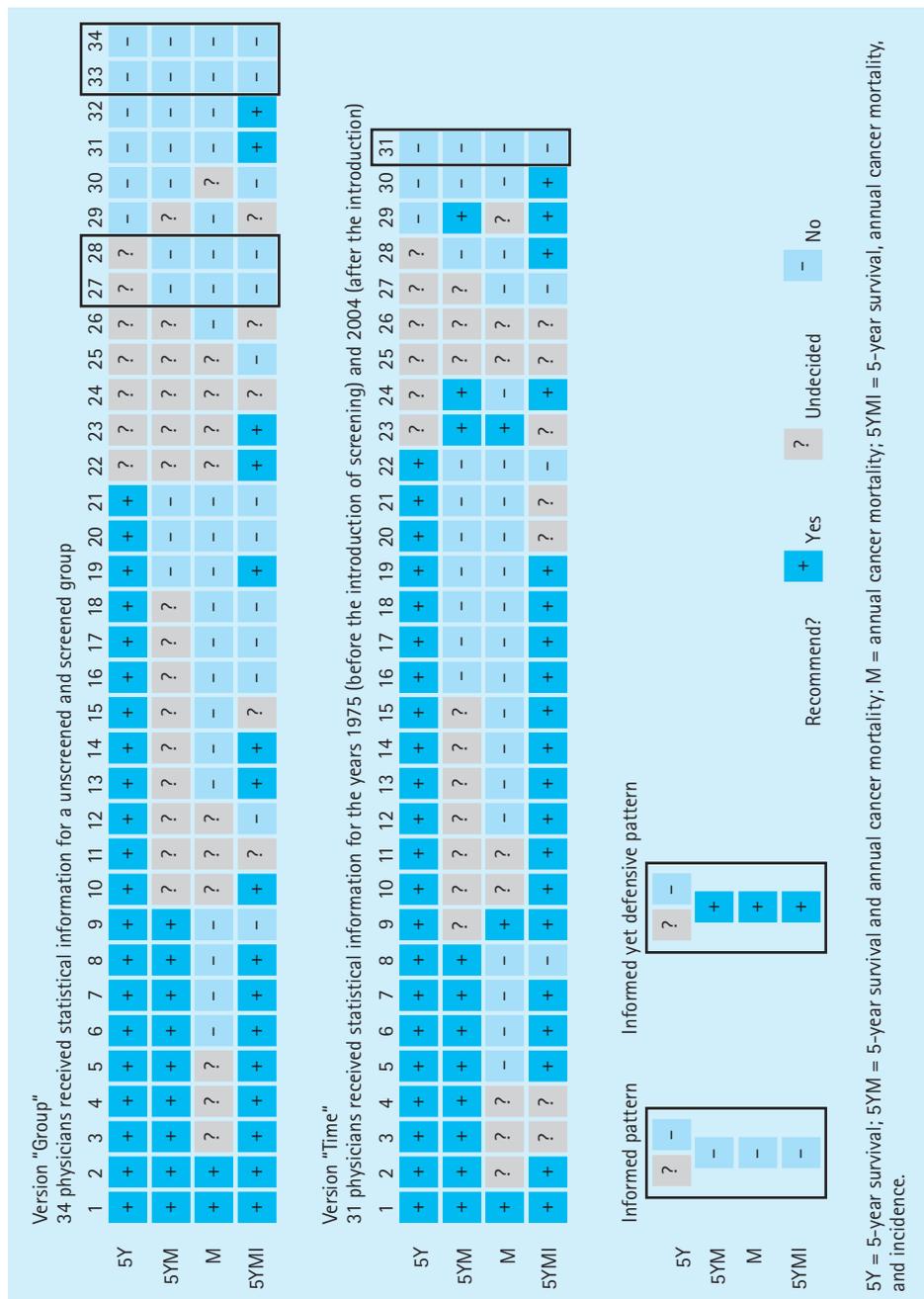


Figure 12. Do physicians understand that mortality rates allow for an unbiased judgment of the benefits of screening, whereas the 5-year survival statistic alone does not? If they understood, they would show either the "informed pattern" or the "informed yet defensive pattern." When asked if they would recommend screening, physicians showing the informed pattern would answer "no" or "undecided" for the condition "5-year survival rate alone" (5Y) and "no" for all other conditions because the mortality rates did not indicate any difference between the groups or time points. Those showing an informed, yet defensive, pattern would also answer "no" or "undecided" for the condition "5-year survival alone" (5Y), but "yes" for all conditions that include the mortality rates. The figure illustrates 65 physicians' screening recommendations: Across the two versions, only 5 physicians showed the informed pattern (highlighted by boxes) and none of them the informed, yet defensive, pattern. These results make clear that the majority of physicians are insufficiently trained to judge whether screening is effective or not, and, therefore, are unable to accurately inform their patients.

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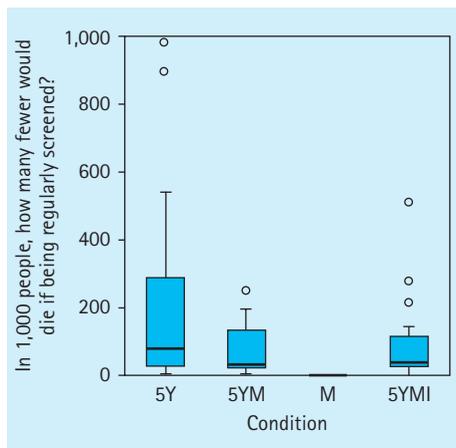


Figure 13. Physicians tend to overestimate the benefit of cancer screening when they are given information in terms of 5-year survival rates. Estimates were based on the question "Out of 1,000 people, how many fewer will die of tumor X if they regularly attend screening?" The absolute risk reduction was zero. Overestimation is highest when only 5-year survival rates are communicated. Conditions: 5Y = 5-year survival; 5YM = 5-year survival and annual disease-specific mortality; M = annual disease-specific mortality; and 5YMI = 5-year survival, annual disease-specific mortality, and incidence.

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thought it to be effective. What would an informed recommendation look like? The 5-year survival statistic alone does not allow an unbiased judgment of the benefit of screening. Thus, if physicians are aware of this problem, they should choose either a "no" or "I can't decide" recommendation in condition 5Y. The other three conditions provide information on disease-specific mortality which allows an evaluation of the effect. Because the SEER study showed no decrease in mortality in the group receiving screening (setting "screened group" or "later time point"), but instead a slight *increase* in mortality, a statistically literate physician should choose "no" in these three conditions. Therefore, an informed pattern of recommendation over the four conditions should be: I can't decide/no, no, no, and no (Figure 12).

Figure 12 shows the actual pattern of recommendations for each physician across the four conditions—ordered by the number of "yes" choices. The "group" and "time" settings yielded similar response patterns. Only 4 physicians in the "group" setting ($n = 34$) and

1 physician in the "time" setting ($n = 31$) answered correctly, that is, showed the informed pattern of recommendation. In contrast, the far majority of physicians recommended screening more often when the 5-year survival rate was given (5Y, 5YM, 5YMI) than in the condition with disease-specific mortality (M). For instance, 43 of 65 physicians recommended screening when presented solely with 5-year survival rates, whereas only 5 of these same physicians did so when presented solely with mortality rates. When asked for the reasons for their recommendation, physicians' most frequent answer was that the 5-year survival rates had increased over time or across groups. Many physicians described this increase as "meaningful," "clinically significant," or "exemplifying the merits of early detection." Recommendations against screening were mainly triggered by the lack of positive difference in mortality rates and the impression that the benefit was either negative or did not exist.

The misleading influence of 5-year survival rates on physicians' judgment of the screening's effectiveness was similar. Across settings, 51 of the 65 physicians judged the screening to be effective when presented with 5-year survival rates, but only 3 still did when shown mortality rates. Similarly, when physicians were asked how many fewer people would die (out of 1,000) from cancer if they were regularly screened, they overestimated the correct number (zero) in all conditions that included 5-year survival rates (Figure 13). When asked about the lead-time bias, 54 of 65 physicians did not know what this concept means; and of the other 11 who thought they did, only 2 could explain the bias correctly. When asked about the overdiagnosis bias, only one thought he knew, but his explanation bore no resemblance with the phenomenon. This study is the first to investigate whether physicians understand 5-year survival rates. It reveals that the far majority of physicians are misled by the differences in survival rates with which screening is commonly advertised, mistaking these for differences in mortality rates. Medical schools urgently need to begin teaching students to understand health statistics.

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Defensive Decision Making by Swiss Physicians

One might assume that doctors are free to treat their patients according to the best evidence. Yet, this is not the case. Tort law in many countries and jurisdictions not only discourages but actively penalizes physicians who practice evidence-based medicine. For instance, Daniel Merenstein, a young family physician in Virginia, was sued in 2003 because he had not automatically ordered a PSA test for a patient, but instead followed the recommendations of leading medical organizations and informed the patient about the pros and cons of the test. The patient later developed an incurable form of prostate cancer. The plaintiff's attorney claimed that PSA screening is standard in the Commonwealth of Virginia and that physicians routinely order the test without informing their patients. The jury exonerated Merenstein, but his residency was found liable for US\$ 1 million. After this experience, Merenstein felt he had no choice but to practice defensive medicine, even at the risk of causing unnecessary harm: "I order more tests now, am more nervous around patients; I am not the doctor I should be." (Gigerenzer et al., 2007, p. 161)

The term "defensive medicine" refers to the practice of recommending a test or treatment that is not the best option for the patient, but one that protects the physician against the patient as a potential plaintiff. Defensive medicine is a reaction to the rising costs of malpractice insurance premiums and patients' bias to sue for missed or delayed diagnosis or treatment. The saying goes: "No one is ever sued for overtreatment." Almost all (93%) of 824 surgeons, obstetricians, and other United States specialists at high risk of litigation reported practicing defensive medicine, such as ordering unnecessary CTs, biopsies, and MRIs, and prescribing more antibiotics than medically indicated (Studdert et al., 2005). Is defensive medicine a phenomenon particular to the United States or does it also occur in European countries, where trials, such as that of Dr. Merenstein, are unthinkable?

At a continuing medical education conference in Switzerland, 552 general physicians and internists were asked whether they believed

that the PSA test is an effective test (that its benefits outweigh potential harms for the patient) and whether they generally recommend the test to patients (Steurer et al., 2009). Two hundred fifty (45%) returned the questionnaire. Only about half of the physicians (56% of the general physicians and 53% of the internists) believed that regular PSA screening is an effective test and that its advantages outweigh potential harm. Yet, in both groups, 75% recommend regular PSA screening to men older than 50 years of age. Forty-one percent of the general practitioners and 43% of internists said that they sometimes or often recommend this test for legal reasons. The result of this study indicates that defensive medicine exists in Switzerland. Apart from legal concerns, monetary motives could also affect physicians' recommendations. However, as a Swiss physician earns less than 10 Swiss francs for ordering a PSA test, monetary incentives may play a minor role. A further factor might be that some physicians do not know the legal situation. For instance, Australian guidelines also do not recommend regular PSA screening, but nearly all of the physicians, surveyed in an Australian study, recommend this test to men over 50 years of age and only about one quarter of them knew that they are legally protected when they do not conduct screening. The overdiagnosis documented in this study is consistent with the overtreatment among Swiss gynecologists, who perform hysterectomies on 16% of the general public, compared to only 10% on physicians' wives. Defensive decision making among Swiss physicians is a surprising result, given that in Switzerland physicians who do not recommend interventions whose effectiveness is controversial need not fear litigation.

Helping Patients With Low Numeracy to Understand Medical Information

If the chance of winning a car in a lottery is 1 in 1,000, what percentage of tickets win a car? For most academics, the answer 0.1% is straightforward. Yet, this question proved to be the most difficult one in a simple numeracy scale (Table 6). Only 46% of 1,001 Germans and 24% of 1,009 Americans provided this

Table 6
Items of the Numeracy Scale and Percent of Germans ($n = 1,001$) and Americans ($n = 1,009$)
in Probabilistic National Samples Answering Correctly

	Germany	US
(1) Imagining that we flip a fair coin 1,000 times. What is your best guess about how many times the coin will come up heads in 1,000 flips?	72.6%	73.2%
(2) In the Bingo Lottery, the chance of winning a \$10 prize is 1%. What is your best guess about how many people will win a \$10 prize if 1,000 people each buy a single ticket?	67.6%	57.7%
(3) In the Daily Times Sweepstakes, the chance of winning a car is 1 in 1,000. What percent of tickets for the Daily Times Sweepstake win a car?	46.3%	23.5%
(4) Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die will come up even (2, 4, or 6)?	63.5%	57.1%
(5) Which of the following numbers represents the biggest risk of getting a disease? 1 in 100, 1 in 1,000, or 1 in 10?	71.8%	75.3%
(6) Which of the following represents the biggest risk of getting a disease? 1%, 10%, or 5%?	78.6%	83.1%
(7) If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1,000?	88.8%	83.1%
(8) If the chance of getting a disease is 20 out of 100, this would be the same as having a ____% chance of getting the disease.	72.8%	70.3%
(9) If Person A's chance of getting a disease is 1 in 100 in 10 years, and Person B's risk is double that of A, what is B's risk?	54.5%	57.3%

answer (Galesic & Garcia-Retamero, 2010). This study is one of the few that used probabilistic national samples rather than selected convenience samples of participants. Most strikingly, variability in numeracy between people with lower or higher education was much larger in the United States than in Germany. Whereas college-educated Americans could answer as many items (about 80%) correctly as their German peers, Americans with less than a high-school diploma could answer only 40% of the items correctly, compared to 60% among Germans. Differences in educational systems—in particular the stronger focus on mathematics and science education in Germany—are likely to be the main factor underlying this discrepancy. Lack of numeracy in the general population has implications for medical decision making. For example, almost 30% of the German and United States citizens could not say whether 1 in 10, 1 in 100, or 1 in 1,000 represents the largest risk. Although the focus of this study

is on the patient, it should be added that 21 out of 85 of American physicians at grand rounds (= 25%) were also not able to translate 1 in 1,000 into 0.1% (see Gigerenzer et al., 2007).

How can we remedy the problem of low numeracy? One proposal is to communicate risks in graphs rather than numbers. It is often assumed that a picture says more than a thousand words. Bar charts, pie charts, and line plots were first used in the late 18th and early 19th centuries. William Playfair, an economist and author of *Commercial and political atlas* (1786) and *Statistical breviary* (1801) was one of the first to use these graphical formats (Figure 14). Icon arrays are even more recent: They began to be widely used only in the early 20th century, promoted by Otto Neurath (1882–1945), a prominent member of the Vienna Circle, to explain social and economic facts to the mostly uneducated Viennese (Figure 15). Will people with low numeracy understand such graphs intuitively?

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Figure 14. Example of the first pie charts by William Playfair (left, end of 18th century) and one of the first icon arrays by Otto Neurath (right, beginning of 20th century).

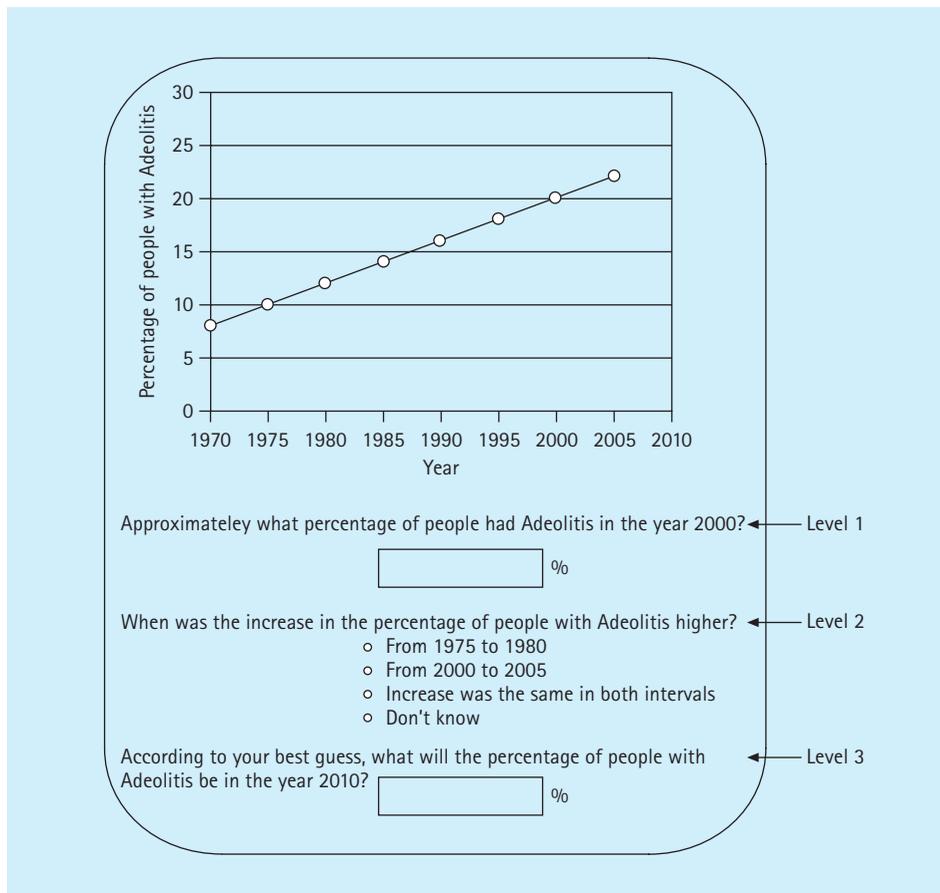


Figure 15. Example of an item from the graph-literacy scale (Galesic & Garcia-Retamero, in press-b)

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To answer this question, Galesic and Garcia-Retamero (in press-b) developed a scale to measure basic graph-literacy skills needed to understand risks in the health domain. The items measure the ability to read the data in a graph, understand relationships, and project beyond the data (Figure 15). The scale has good psychometric properties and takes about 10 minutes to complete. It was used to investigate graph-literacy skills of the general population in Germany and the United States using probabilistic national samples. The results show that substantial parts of both populations cannot perform elementary tasks involving even the simplest graphs. For example, 16% of Americans and 12% of Germans do not know what a quarter of a pie chart is in percentages. Similarly, 15% of people in the United States and 17% in Germany cannot read the height of a bar chart with fully labeled axes and gridlines as an additional help.

Garcia-Retamero and Galesic (2010a) showed that patients with low numeracy can be helped with graphical aids. Icon arrays improved the performance of low-numeracy participants almost to the level of high-numeracy ones, but only if they had a sufficient level of graph literacy. The results indicate the possibility of compensating low numeracy by high graph literacy. They also point to the need for investigating graphical presentation formats that are intuitively understandable to the least educated patients, including the total number of icons, the kind of analogies, and the use of comparison risks rooted in patients' everyday experiences.

A Brief Analysis of Flawed Risk Communication: The "Swine Flu" Pandemic (H1N1) in 2009

The influenza pandemic (H1N1) in 2009 exemplified many of the difficulties policy makers have in communicating risk to the public: (1) Available and missing evidence was not communicated transparently and completely; (2) rather than informing citizens, officials treated them paternalistically; and (3) public trust in vaccinations and institutions was damaged as a result of (1) and (2).

Intransparent and Incomplete Information

In February 2009, the World Health Organization (WHO) redefined pandemics as diseases that spread across multiple WHO regions, without reference to disease severity. Two months later, the WHO released estimates of 2–7.4 million H1N1 deaths (and 2 billion infections) worldwide. Thus, when the WHO declared the H1N1 influenza a pandemic in June 2009, most citizens and many decision makers were misled to believe that the H1N1 influenza was spreading worldwide and had severe consequences. In reality, until July 2010, the WHO counted "only" 18,366 H1N1 deaths. Although the WHO knew as early as June 2009 that the H1N1 virus would not be as aggressive as expected, they did not inform the public accordingly.

Paternalism

In August 2009, the winter season in the southern hemisphere was over and had resulted in considerably fewer H1N1 deaths (130) than the seasonal flu deaths on average (1,500 to 3,000). Even then, officials did not change information policy. In October 2009, a German official predicted up to 35,000 H1N1 deaths in Germany. The same official stated later that such "early and dramatic warnings [were] necessary [because] many self-proclaimed and unauthorized experts were using all possible and assumed harms of the vaccination to argue against it." In reality, scientific evidence about benefits and harms of the vaccination was scarce. The media amplified this form of paternalism by inviting experts to argue for or against the vaccination rather than to provide evidence or point out the lack thereof.

Loss of Public Trust in Vaccinations and Institutions

Evidence-free controversies, intransparent communication of uncertain evidence, and a fairly benign course of the H1N1 influenza resulted in the emergence, rebuttal, and reemergence of conspiracy theories. Thus, the lack of transparent risk communication "may yet claim its biggest victim—the credibility of the WHO and the trust in the global public health system" (Cohen & Carter, 2010,

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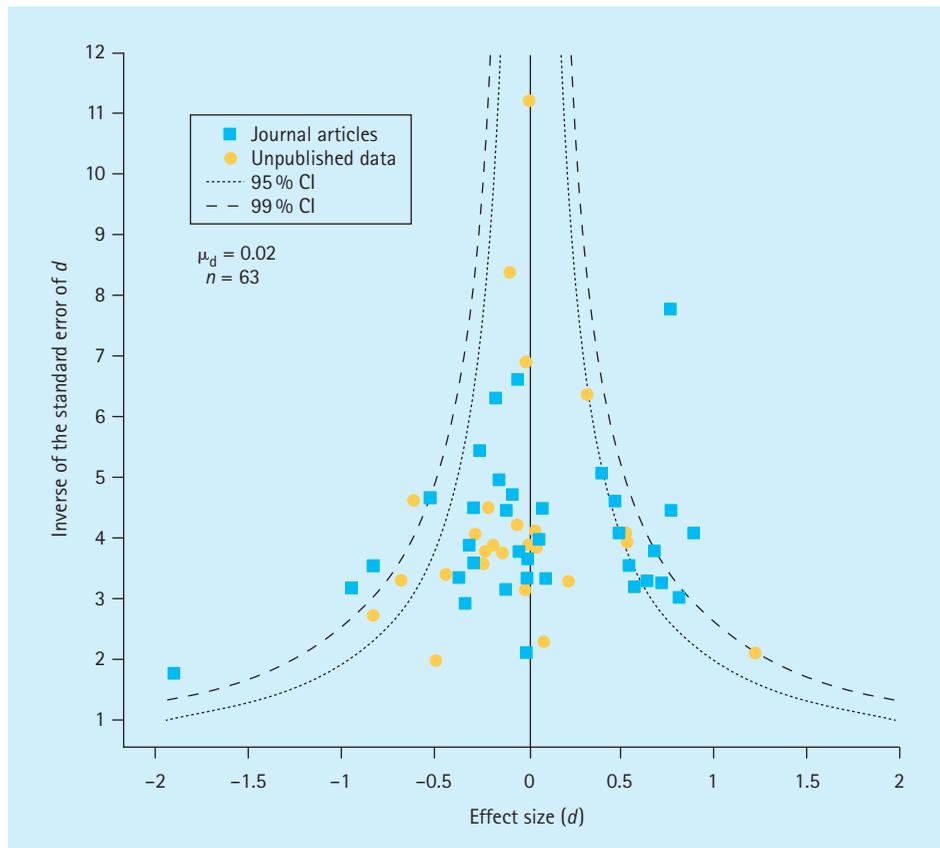


Figure 16. Does the too-much-choice effect exist? A meta-analysis of 63 experimental conditions in which the too-much-choice effect was investigated. Effect sizes are measured by Cohen's d and plotted against their inverse standard error, which determines the weight that each condition carries in the meta-analysis. A positive d indicates a too-much-choice effect, while a negative d indicates a more-choice-is-better effect. The dotted and dashed lines indicate confidence intervals (CI) under the assumption that the data set is homogeneous and normally distributed around the mean effect size.

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p. 1279). To avoid this risk of risk communication, the following measures should be adopted by policy makers: transparent descriptions of situations instead of buzzwords, such as "pandemic;" transparent communication of existing and missing evidence instead of dramatic estimates; and disclosure of political decision processes and conflicts of interest.

The "Too-Much-Choice" Effect: A Mean Effect Size of Zero?

Customers face an ever-increasing number of options to choose from. While individuals may be attracted by this variety, some scholars argue that an overabundance of choice might eventually lead to a decrease in the motivation to buy or the satisfaction

with the option finally chosen. For instance, a classic experiment in an upscale supermarket in Menlo Park, California, reported that with 6 varieties of jam offered at a tasting booth, 30% of shoppers bought one or more, but with 24 varieties only 3% did so (Iyengar & Lepper, 2000). This has been dubbed the too-much-choice effect. The possibility of a negative effect of large assortment sizes challenges neoclassical theories in economics and marketing, according to which expanding a choice set cannot be detrimental to decision makers. From an applied perspective, marketers and public policy makers might need to rethink their practice of providing ever-increasing assortments of mustards, olive oil, and chips.

In his dissertation, Scheibehenne (2008) tried to replicate the findings of the experiments reported by Iyengar and Lepper (2000). Yet, in a total of eight studies he could not find a too-much-choice effect, neither in supermarkets in Germany nor in the United States. This negative result called for a more systematic meta-analysis of published and unpublished studies. Scheibehenne, Greifeneder, and Todd (2010) analyzed 63 experimental conditions with a total of 5,036 participants. Figure 16 shows that the mean effect size of the too-much-choice effect across all conditions turned out to be virtually zero (mean $d = 0.02$, CI95 -0.09 to 0.13). The effect also did not depend on the difference in size between the small set and the large set, and there was

no curvilinear relationship between assortment size and choice overload. A subsequent metaregression further indicated that a more-choice-is-better effect may be expected for studies that use (food) consumption as a dependent measure or if decision makers have strong preferences prior to making a choice. Also, published articles were somewhat more likely to report a too-much-choice effect, as compared to unpublished manuscripts. These results do not rule out that too-much-choice effects might exist in specific domains. But if one exists, it is essential for identification purposes to develop a more theory-driven understanding of the decision processes that people adopt.

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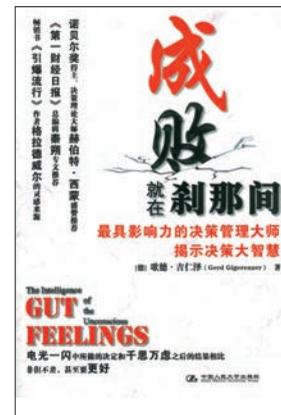
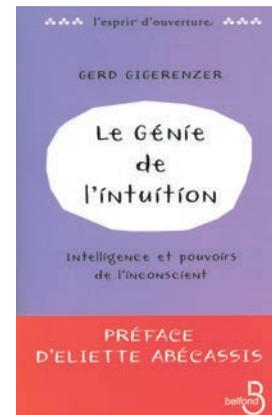
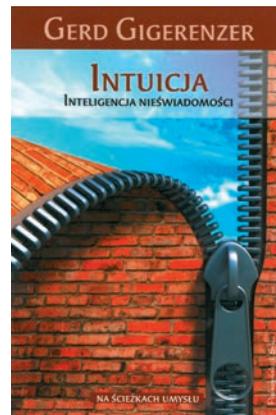
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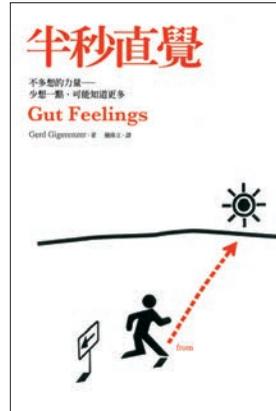
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**Center for
Educational Research**

The Center for Educational Research

The **Center for Educational Research** (Director: Jürgen Baumert) examines learning and development from an institutional point of view. Educational settings such as schools offer a variety of developmental opportunities, but at the same time exclude others. The impact of such settings is investigated from three perspectives: (1) the long-term consequences of schools' opportunity structures on individual development in terms of cognitive competencies as well as motivational and social resources; (2) international comparison of the outcomes of schooling in the fields of reading comprehension, mathematics and science literacy; and (3) improvement of learning and instruction in terms of the cognitive activation of students, mainly in science and mathematics.



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Introductory Overview

The specific concern of the Center for Educational Research (CER) is the study of development and learning from the perspective of institutionalized education. Educational settings such as schools provide a specific structure of opportunities and constraints for learning and development. This structure offers a variety of developmental opportunities, but at the same time excludes others. How do the learning gains of students in different schools or school types differ? How do teachers' pedagogical knowledge, content knowledge, and pedagogical content knowledge differ, and to what extent do these differences influence student learning gains? How do aspects of schooling affect the intra- and interindividual differentiation of personality traits and guide career-forming processes? How strongly do students themselves actively influence their own academic development—for example, by selecting or switching learning environments? What role does family background play in student development, the selection of learning environments, and the optimization of academic outcomes? These and other questions are explored by a multidisciplinary team including educational scientists, psychologists, mathematicians, and sociologists.

Conceptual Orientation: Knowledge Acquisition and Psychosocial Development in the Context of Institutional Learning Settings

Learning in institutional settings is a complex and multidetermined process. It is fundamentally difficult to determine whether a school career and a student's learning outcomes can be described as successful. It is even more difficult to identify the causes of success or failure. Although popular with the public, press, and policy makers, simple explanatory models relying on a single factor to explain successful or unsuccessful learning processes are usually insufficient, if not entirely misleading. Given the complexity of learning in institutional contexts, our Center's research program is guided by multiple perspectives. The interactive nature of individual student characteristics and institutionalized learning settings must be taken into account. In all of our research, learners are perceived as the coproducers of their own development. Special attention is paid to how cognitive activation and self-regulation can be stimulated and supported by instructional environments. Moreover, we assume that individual students proactively select and shape their developmental environments. A comprehensive analysis of institutional opportunities and constraints requires researchers to consider several contextual levels, including countries, schools, classrooms, and the family. Accordingly, our research is

embedded in a multilevel perspective, both conceptually and methodologically, and addresses these different contextual levels. It is important to analyze the effects of various facets of these learning contexts simultaneously. For this reason, our research models incorporate conceptually different facets, such as the curriculum, the quality of instruction, and the composition of the learning group. Because both educational systems and society as a whole change over time, it is crucial that researchers remain attuned to the historical time in which learning takes place. We therefore embed our research in historical analyses and conduct studies to document the effects of changes in institutional settings. The domain specificity of knowledge acquisition is determined by the way in which educational institutions structure content areas into different academic subjects. Our research focuses on domains of knowledge, such as reading, mathematics, English as a foreign language, and sciences. These domains represent basic cultural tools that are critical for individual development in modern societies. Although the acquisition of knowledge in core domains is the central variable in learning settings, it is not the only aspect of interest. We also investigate students' motivation, personality, personal goals, and values as both outcomes of institutional learning and predictors of academic success and choices.

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Schroeder, S., Richter, T., McElvany, N., Hachfeld, A., Baumert, J., Schnotz, W., Horz, H., & Ullrich, M. (2011). Teachers' beliefs, instructional behaviors, and students' engagement in learning from texts with instructional pictures. *Learning and Instruction, 21*, 403–415. doi: 10.1016/j.learninstruc.2010.06.001

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We use various methodological approaches to identify powerful learning environments, with experiments and intervention studies complementing large-scale longitudinal studies.

Summary Outline

Work at the Center for Educational Research is organized into four Research Areas, which also provide the structure for this Research Report. It should, however, be noted that there is considerable overlap between the Research Areas in terms of researchers, topics, and methods.

Research Area I focuses on the relationship between the opportunity structures of schools and the optimization of individual development in terms of cognitive competencies, motivational and social resources, value commitment, and successful transitions to university education, vocational training, and the labor market.

Research Area II examines how institutional, individual, and familial factors relate to transitions in the educational system. A main focus of the activities in this Research Area is the Center's participation in the Trends in International Mathematics and Science Study (TIMSS), with the development of an additional module to examine the transition from elementary to secondary school. Another emphasis is on the transition from school to university.

The research questions addressed within Research Area III draw on a key finding of PISA 2000, 2003, and 2006. In Germany, at least 25% of the upcoming generation can be identified as potentially at risk in terms of reading literacy. Research Area III uses longitudinal, cross-correlational, and experimental studies to examine how students' reading literacy and language skills develop, and how they can be effectively assessed and promoted.

Research Area IV investigates teacher competence as an important antecedent of educational quality. Drawing on earlier research that identified factors of successful learning environments, the research focus has shifted to the role that teachers play in creating such high-quality instructional settings. Based on a theoretical model of teacher competence, we

investigate how teachers' knowledge, beliefs, and psychological functioning determine their instructional practices. Moreover, we examine how these aspects of teacher competence are shaped and changed within formal learning settings, such as the practical phase of teacher education.

Transformation of the Center for Educational Research to a Virtual Network

From 1996 to 2010, over a period of 14 years, work at the Center for Educational Research has been characterized by continuity and progressive development across successive generations of researchers. The specific concern of the Center has been the study of development and learning from the perspective of institutionalized education. The Center, with its four Research Areas, has profoundly influenced the agenda of educational research in Germany. This applies in equal measure to the study of how institutional opportunities and constraints influence individual developmental trajectories; to the analysis of critical points of transition in childhood, adolescence, and young adulthood; and to the examination of learning and instruction from a domain-specific perspective. What began in 1996 at the Max Planck Institute for Human Development as an integrated and coherent long-term research program has now developed into a dynamic and vibrant network. In an almost natural process, the program has come to its planned conclusion at the Max Planck Institute for Human Development and, at the same time, is being continued, in new and evolved form, in other locations. The large-scale longitudinal studies on institutional influences have moved to the University of Tübingen (Ulrich Trautwein); research on transitions in the educational system is being continued from a lifespan perspective at the University of Potsdam (Kai Maaz); intervention-based reading research has gone to the University of Dortmund (Nele McElvany); and research on teacher competence, instructional quality, and student progress is now based at the University of Frankfurt a. M. (Mareike Kunter). These new centers have developed their own dynamic and innovative research agendas. Finally, the new Berlin

study, which takes advantage of a unique historical opportunity to examine the effects of the reform of Berlin's secondary system to a two-track system in a natural experiment, links Jürgen Baumert's emeritus position at the Max Planck Institute for Human Development in Berlin with the University of Potsdam (Kai Maaz) and the Leibniz Institute for Science and Mathematics Education (IPN) in Kiel (Olaf Köller).

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Research Area I: Opportunity Structures of School and Individual Development in Adolescence and Young Adulthood

The successful development of human beings across the lifespan is dependent both on individual characteristics and on external socializers, such as significant others and social institutions. The social institution of school plays a major role during childhood and adolescence, particularly in the domain of academic learning and, more generally, cognitive development. Furthermore, schools influence the development of motivation, emotions, attitudes, and other personal characteristics. Major research topics addressed in Research Area I include the opportunity structures open to students from different backgrounds, academic achievement trajectories across secondary education, the educational standards attained in German upper secondary schools, the comparability of the school-leaving qualifications awarded across Germany, and determinants and consequences of different academic biographies. Research Area I was one of the cornerstones of the Center for Educational Research from its foundation in 1996 until Jürgen Baumert's retirement in mid-2010, yielding a multitude of theoretically and practically significant findings. In this report, we outline the empirical databases used and several key findings of Research Area I, describe results from one study (TOSCA-Repeat) in more depth, and, finally, give an outlook on how the projects will continue after conclusion of the Center's work.

The Empirical Database

Given its theoretical focus on institutional influences on human development, the research conducted within Research Area I entails longitudinal multilevel studies that collect data at the country, state, school, class, and individual levels, cover more than one knowledge domain, and allow both intraindividual change across domains and interindividual differences in patterns of intraindividual change to be investigated. The Research Area's flagship studies were designed to investigate how learning contexts in school and college environments affect human development while meeting the requirements of multilevel longitudinal designs. This applies to *Learning Processes, Educational Careers, and Psychosocial Development in Adolescence and Young Adulthood* (BIJU; see Figure 4); *Transformation of the Secondary School System and Academic Careers* (TOSCA; see Figure 5); and *Tradition and Innovation: Development at Hauptschule and Realschule in Baden-Wuerttemberg and at Mittelschule in Saxony* (TRAIN; see Figure 6). The analyses conducted in Research Area I also draw on PISA and TIMSS data as well as on additional data sets collected at our Center. Because the longitudinal modeling of hierarchically structured data is methodologically difficult, data analysis requires specific and complex methods, and our Center is

involved in optimizing research designs and analytical strategies.

Schools as Differential Learning Environments: An Overview of Recent Research

Differential Learning Environments and Academic Achievement

One continued focus of research has been on student performance and learning gains in differential learning environments. Germany is well known for its differentiated secondary system, with the vocational track *Hauptschule*, intermediate track *Realschule*, and academic track *Gymnasium*. However, there is currently much flux in the structure of the school system in many German states, with several states reducing the number of secondary school types to two. A main hypothesis of our Research Center is that the different school types represent differential developmental environments, potentially resulting in differential student learning gains across school types. There are three main explanatory approaches to this "fan-spread effect." The first explanation attributes differential developmental trajectories in German secondary schools to differences in students' performance and learning speed that existed before they entered secondary school. Thus, differing developmental trajectories are an expression of differential learning rates

and a function of entrance selectivity to the three school types. The second approach focuses on the differential effects of school types and school systems relying on differing timetables, curricula, teacher training, and teaching cultures; these effects are “institutional” in nature. The third explanation refers to composition effects arising from differences in the achievement, social and cultural background, and educational biographies of student populations. According to this approach, differences in learning trajectories are not, or are only partially, dependent on attending a certain school type. Rather, they are a consequence of the characteristics of the specific learning group. It is quite possible that all of these influences take effect at the same time.

Baumert, Becker, Neumann, and Nikolova (2009, 2010) examined whether students' learning gains in reading, mathematics, and English depend on the time of their transition from elementary school to the academic track (*Gymnasium*) of secondary schooling (grade 4 vs. grade 6) and on the profile of the academic track attended. In contrast to most German states, students in Berlin generally transfer to the secondary education after grade 6. However, between 7% and 8% of students are allowed to transfer earlier, after grade 4, to one of about 30 *Gymnasium* schools with specific curricular profiles. Baumert et al. (2009, 2010) examined whether high-performing students who took the opportunity to transfer to *Gymnasium* after grade 4 achieved higher learning gains than comparable students who stayed in primary school for grades 5 and 6. Based on data from the Berlin ELEMENT study, the learning gains of grade 5 and 6 students in elementary ($N = 3,169$) and *Gymnasium* ($N = 1,758$) schools were modeled using propensity score matching (PSM) analysis.

When achievement-related differences at the end of grade 4 were controlled, no statistically significant differences in reading comprehension were found between the student groups at the end of grade 6. The results for mathematics were similar, although substantial differences emerged in favor of a single *Gymnasium* that had not yet developed a specific curricular profile at the time of the

assessments. In English, where curricular differences between the different tracks are more pronounced, positive results emerged relative to elementary schools for schools with accelerated profiles, for schools with a bilingual profile, and for the *Gymnasium* without a specific profile; the findings for *Gymnasium* schools focusing on the classics were negative. These findings refute the common assumption that early transition to the academic track of secondary schooling has generally positive effects on the reading and mathematics literacy of high-performing students. The findings for English indicate that differences in learning trajectories may be more pronounced when different educational programs are associated with differences in classroom instruction.

Differential Learning Environments: Impacting Student Self-Concept

The effects of differential learning environments are not restricted to the domain of academic achievement but also apply to student motivation, emotion, and behavior. In a series of studies, we have continued our research program examining frame-of-reference effects on self-related cognitions. An overview of this research agenda can be found in Trautwein and Lüdtke (2010). Herbert Marsh coined the term *Big-Fish-Little-Pond Effect* (BFLPE) to describe reference group effects in self-concept development. Results from a large number of studies indicate that a student's academic self-concept is negatively influenced by the achievement of others in his or her school (a frame of reference effect). Moreover, there is evidence that this negative frame of reference effect is not, or only slightly, reduced by the quality, standing, or prestige of the track or school attended (a “reflected glory” effect). Going beyond prior studies, Trautwein, Lüdtke, Marsh, and Nagy (2009) used both between-school and within-school approaches to investigate frame of reference and reflected glory effects, incorporating students' own perceptions of the standing of their school and class. Multi-level analyses were performed with data from the TOSCA project (three studies with 4,810, 1,502, and 4,247 students, respectively). Find-

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ings from all three studies showed that, given comparable individual achievement, placement in high-achieving learning groups was associated with comparatively low academic self-concepts. However, students' academic self-concept was not merely a reflection of their relative position within the class but also substantively associated with their individual and shared perceptions of the class's standing. Moreover, the negative effects of being placed in high-achieving learning groups were weaker for high-achieving students. Overall, the studies support both educational and social psychology theorizing on social comparison.

Frame-of-reference effects are not restricted to academic self-concepts, however. Milek, Lüdtke, Trautwein, Maaz, and Stubbe (2010) examined the extent to which teachers' recommendations of a secondary track were systematically related to class-mean achievement level and whether there were differences in the strength of this reference group effect across the federal states. Based on a subsample of the German dataset from the 2006 cycle of the *Progress in International Reading Literacy Study* (PIRLS) (4,589 students from 248 grade 4 classes), multilevel logistic regression models were used to compare the relationship between the recommendations made by elementary school teachers and class-mean achievement level in Baden-Wuerttemberg, Bavaria, Hesse, North Rhine-Westphalia, and a reference group (consisting of students from the states of Schleswig-Holstein, Saxony, Saarland, Thuringia, and Rhineland-Palatinate). Findings for the subsample showed a negative association between class-mean achievement and teachers' recommendations that was mediated by school grades. Cross-state differences in the size of reference group effects did not reach the level of statistical significance.

Differential Learning Environments: The Case of Homework Assignments

We have also continued to address differential learning opportunities within the *Homework as Learning Opportunities* (HALO) project. This project, which has strong links to Research Area IV, uses several data sets to explore the

effects of teachers' homework assignments and students' homework completion. Building on our earlier work, we have systematically expanded our research program in the past 2 years. For instance, in two articles (Dettmers, Trautwein, & Lüdtke, 2009b; Trautwein, Schnyder, Niggli, Neumann, & Lüdtke, 2009), we have challenged the widespread assumption that more time spent on homework is generally associated with higher achievement. Furthermore, we have examined in some detail the role of academic emotions in the context of homework (Dettmers, Trautwein, Lüdtke, Goetz, Frenzel, & Pekrun, 2011; Dettmers, Trautwein, Lüdtke, Kunter, & Baumert, 2010). In addition, we have found further evidence for our hypothesis that the quality of homework assignments differs substantially across classrooms and that these differences are related to important outcomes measures, such as homework effort and school grades (Dettmers, Trautwein, & Lüdtke, 2009a). In another study, we examined whether teachers' homework objectives, implementation practices, and attitudes toward parental involvement are associated with the development of students' homework effort, homework emotions, and achievement during grade 8. A total of 63 teachers of French as a second language and their 1,299 grade 8 students participated in the study. In multilevel models, teachers' homework attitudes and behaviors were specified to predict outcomes at the end of grade 8, controlling for covariates at the beginning of grade 8. A low emphasis on drill and practice tasks and a high emphasis on motivation were associated with favorable developments in homework effort and achievement. Controlling homework assignments were associated with less homework effort and more negative homework emotions; the opposite pattern was found for students whose teacher supported student homework autonomy rather than parental homework involvement.

Differential Learning Environments: Methodological Aspects of Assessing Contextual Effects

Methodological aspects of assessing contextual effects are another area that has received

continued attention over the last 2 years at the Center for Educational Research. A key assumption of most educational research is that cognitive, motivational, emotional, and behavioral student outcomes are substantially shaped by features of the social context, such as learning climate, instructional quality, and the social composition of the class or school. In the last two decades, multilevel modeling (MLM) has become the standard approach for assessing contextual effects in the social sciences. A major strength of MLM lies in the possibility of simultaneously exploring relationships among variables located at different levels. In the typical application of MLM in educational research, outcome variables are related to several predictor variables at the individual level (e.g., students) and at the group level (e.g., schools, classes). Despite the progress that has been made in the estimation of multilevel models in recent decades, however, there are still a number of open questions regarding the assessment of contextual effects in educational research. Our Center's work in this area has focused on two issues. First, group characteristics are frequently assessed by aggregating individual student data across groups. We have evaluated different approaches to assessing the psychometric properties of such aggregated data (Lüdtke & Robitzsch, 2009). Second, we have developed statistical methods that can correct for unreliability when multilevel models are used to estimate contextual effects (Lüdtke et al., 2008; Marsh et al., 2009).

TOSCA-Repeat: Examining the Effects of Institutional Reform at Upper Secondary Level

Major reforms of upper secondary education—the preuniversity track—have been initiated in many of the German states in recent years. German, mathematics, and modern languages have been defined as core subjects, the distinction between basic and advanced *Abitur* courses has been abolished, the number of examination subjects in the *Abitur* has been increased, and opportunities for students to select *Abitur* subjects have been reduced. The primary objective of these reforms is to raise and level the learning bar: to increase overall

performance levels while reducing differences in performance between *Abitur* students. Critics of the reforms have expressed concern at the limitation of students' freedom to choose their subjects; they judge the reforms to be outdated and backward-looking. Our analyses of the student outcomes in the new upper secondary level, which we have presented this year under the title *TOSCA-Repeat*, offer an interim assessment of these reforms. The empirical analyses focus on the state of Baden-Wuerttemberg, which has played a pioneering role in the reform of upper secondary education since the 1990s.

In our analyses, we are able to capitalize on the fact that we assessed students in Baden-Wuerttemberg who had studied for the *Abitur* under the "old conditions" in TOSCA-2002, our first survey of *Abitur* students. By repeating the TOSCA assessment in the 2005/06 school year (TOSCA-2006), we were able to take advantage of a unique historical opportunity to examine the effects of major change in the organization of upper secondary education on *Abitur* students' performance levels and readiness for higher education, as well as on their later success in higher education (Trautwein, Neumann, Nagy, Lüdtke, & Maaz, 2010b).

What has Changed in Baden-Wuerttemberg?

Since the 2001/02 school year, upper secondary education at *Gymnasium* schools offering general education in Baden-Wuerttemberg has changed in the following ways (Neumann, 2010):

- The distinction between basic and advanced courses in the "core competence subjects" of German, modern languages, and mathematics has been abolished. These three subjects are now taught to the full class for four lessons per week. Moreover, students have to take a written examination in all three subjects.
- In addition to these three core competence subjects, students have four lessons a week in both a "profile subject," which depends on the profile of the general *Gymnasium* they are attending (science profile, language profile, fine arts profile, or physical education profile), and an "elective subject,"

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which can be chosen from the range of compulsory subjects.

- The *Abitur* examination now covers five rather than four subjects.
- All students take two science subjects throughout upper secondary level. Previously, it sufficed to take one science subject as a basic or advanced course.

These reforms of upper secondary education in Baden-Wuerttemberg are intended to raise and level the learning bar in German, mathematics, and modern languages. Annette Schavan, who was at the time Minister of Education and Cultural Affairs in Baden-Wuerttemberg, explained the motivation for abolishing the distinction between basic and advanced courses in these three core competence subjects as follows: "In these subjects, it is more important to achieve acceptable proficiency levels for all students than to give a few the opportunity to specialize."

Changes in Mean Instruction Time

The abolition of the distinction between basic and advanced courses in German, mathematics, and modern languages has meant that *Abitur* students in all schools and types of

Gymnasium now receive the same volume of instruction in these subjects (i. e., four lessons per week). As a result, students now generally receive more English and mathematics instruction—on average, 13.1 minutes more mathematics instruction and 10.8 minutes more English instruction per week. The magnitude of this increase differs slightly depending on the type of *Gymnasium* attended: The higher the proportion of students who had previously been enrolled in the 5-hour advanced course, the lower the increase in mean instruction time.

Achievement Levels in Preuniversity Mathematics

We examined whether the reforms implemented have had the intended effect of raising and leveling the bar in preuniversity mathematics using an assessment based on the mathematics content covered at upper secondary level. The assessment has been shown to have high curricular validity in both of the TOSCA cohorts (Nagy & Neumann, 2010).

Overall, the pattern of results for mathematics was in keeping with the objectives of

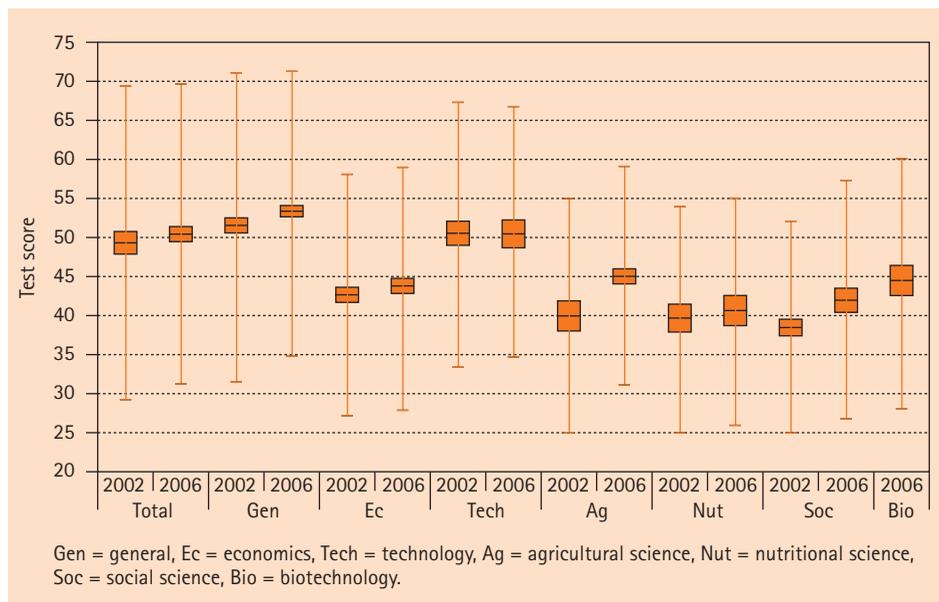


Figure 1. Mean test performance in preuniversity mathematics with 95% confidence intervals (orange rectangles) and distribution of test scores (± 2 standard deviations) in TOSCA-2002 and TOSCA-2006. *Gymnasium* schools specializing in biotechnology did not yet exist in 2002.

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the reforms (Nagy, Neumann, Trautwein, & Lüdtke, 2010). Figure 1 shows the mean test scores (the horizontal lines in the middle of the boxes) and the distributions of test scores in preuniversity mathematics. The distributions indicate the range of performance within which the scores of 95% of the students in the two TOSCA cohorts under investigation fell.

At the level of the total sample of all *Abitur* students, there was a moderate increase in performance and a slight decrease in the distribution of performance of around 4%. The performance gain was somewhat larger in the group of general *Gymnasium* schools than in the total sample; the same applied to the change observed in the distribution of performance, which decreased by about 7%. The strongest performance gains were seen in *Gymnasium* schools specializing in agricultural or social science, where the switch to 4 hours of mathematics per week across the board led to a marked increase in mean weekly instruction time. In contrast, mean performance levels in *Gymnasium* schools specializing in technology remained almost unchanged, as a comparatively high proportion of students in the TOSCA-2002 sample

were enrolled in an advanced level mathematics course.

Was a mean increase in performance seen in all schools? Figure 2 presents change in mean test scores in each individual school. The dots show the mean increase (or decrease) in performance; the vertical lines describe the precision of the measurement (95% confidence intervals). The data show that achievement in many schools improved—but that in others it remained unchanged or worsened. We were able to identify the reasons for these differences between schools in further analyses. The proportion of students in the TOSCA-2002 sample in advanced courses played a key role: The lower the proportion of students in advanced courses, the more positive (or less negative) the change in achievement levels. In terms of the distribution of performance, the reforms were expected to level the bar in students' mathematics achievement both within individual schools and between schools and types of *Gymnasium*. Analyses of the TOSCA-Repeat data revealed a small, but statistically significant, decrease in the distribution of student performance within schools. The data also pointed to reductions in the range of performance between schools

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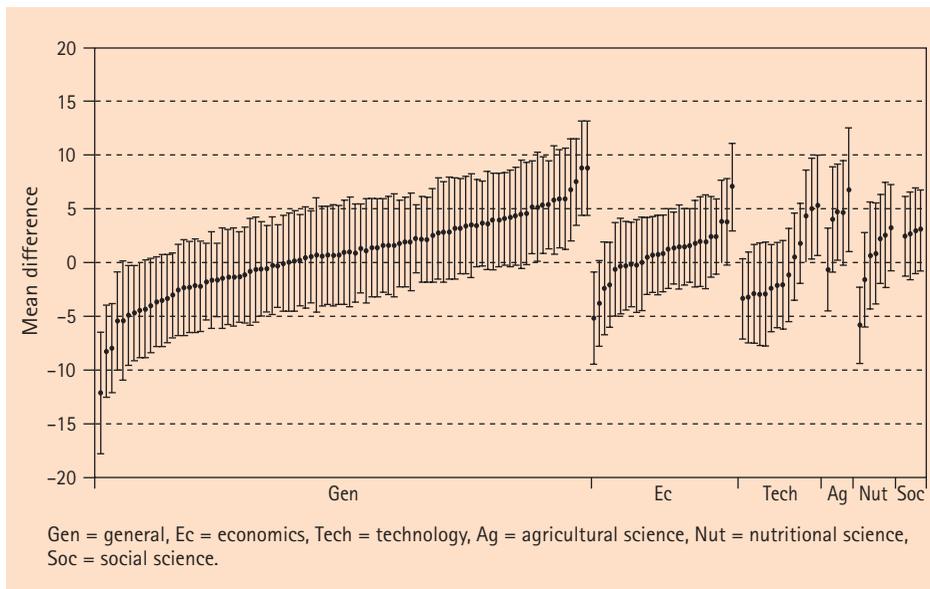


Figure 2. Change in mean performance levels at individual schools between TOSCA-2002 and TOSCA-2006 by type of *Gymnasium*.

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and types of *Gymnasium*, but these differences were not statistically significant.

Achievement Levels in English

An increase in performance levels combined with a reduction in the differences in student performance was also expected for English. English performance was assessed using a short version of the *Test of English as a Foreign Language* (TOEFL), with items tapping reading comprehension, vocabulary, grammar, spelling, and listening comprehension. TOEFL is used by colleges and universities in the United States and beyond to evaluate the English proficiency of applicants who speak English as a second language. Less prestigious universities require minimum TOEFL scores of 500 on the version of the TOEFL administered in TOSCA, more prestigious universities a score of 550, and top universities, such as Yale or Stanford, a score of 600. Figure 3 shows the means and distributions of English test scores in the two TOSCA cohorts by type of *Gymnasium*.

In contrast to the findings for preuniversity mathematics, there was as good as no change in mean achievement levels in English

(Jonkmann, Trautwein, Nagy, & Köller, 2010) in either the total sample or the individual types of *Gymnasium*. However, the data did point to a decrease in the distribution of performance in English in TOSCA-2006, which was primarily attributable to a reduction in differences in student performance in general *Gymnasium* schools. Overall, however, the level of English achievement was surprisingly stable.

Conclusions and Outlook

To summarize the findings available to date from the TOSCA-Repeat study, we can conclude that the objectives of the reforms have been achieved in certain respects (moderate increase in performance levels and decrease in the range of performance in mathematics, decrease in the range of performance in English), although it is difficult to evaluate the practical relevance of the changes observed. In other respects, however, we found no evidence that the reforms have had the intended effects (e.g., no increase in English performance). However, only part of the data has, as yet, been analyzed. Various other questions (e.g., effects on performance

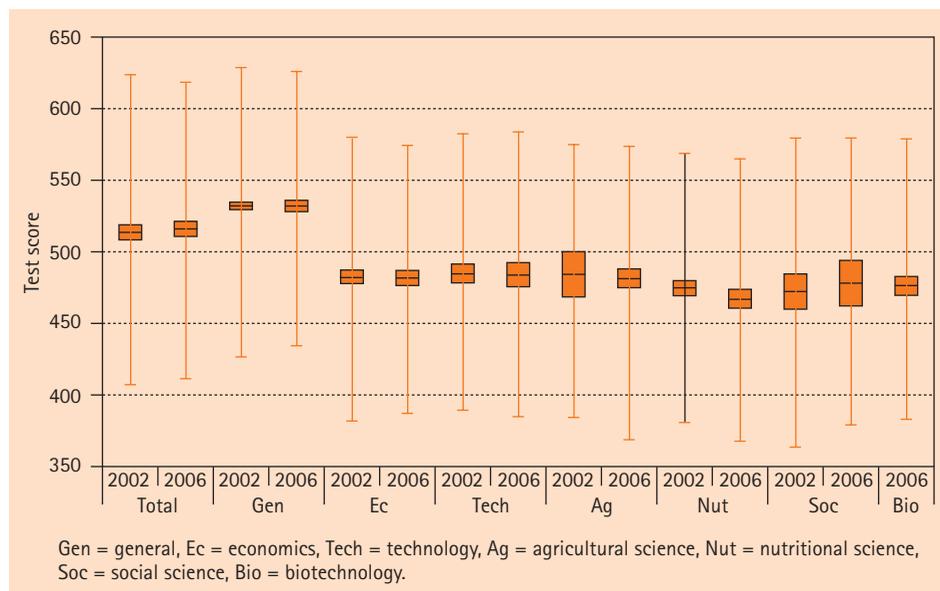


Figure 3. Mean test performance in English (TOEFL) with 95% confidence intervals (orange rectangles) and distribution of test scores (± 2 standard deviations) in TOSCA-2002 and TOSCA-2006. *Gymnasium* schools specializing in biotechnology did not yet exist in 2002.

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in German, history, and other subjects) cannot be addressed on the basis of the TOSCA data, as these subjects were not assessed. Analysis of the wealth of data generated by the TOSCA study will continue for several years. For example, we plan to examine which student and school characteristics predict *Abitur* students' success in their university and professional careers and whether this success is associated with the reform of upper secondary education. These findings are likely to influence the overall assessment of the reforms—in one direction or the other.

Research Area I: Looking Back and Ahead

The work accomplished in Research Area I has been of central importance within the Center for Educational Research since its foundation in 1996. Much progress has been made in understanding how school systems, schools, and classes become differential learning and developmental contexts that impact important student outcomes, such as achievement, self-concepts, and educational biographies. Although work in this field at the Institute

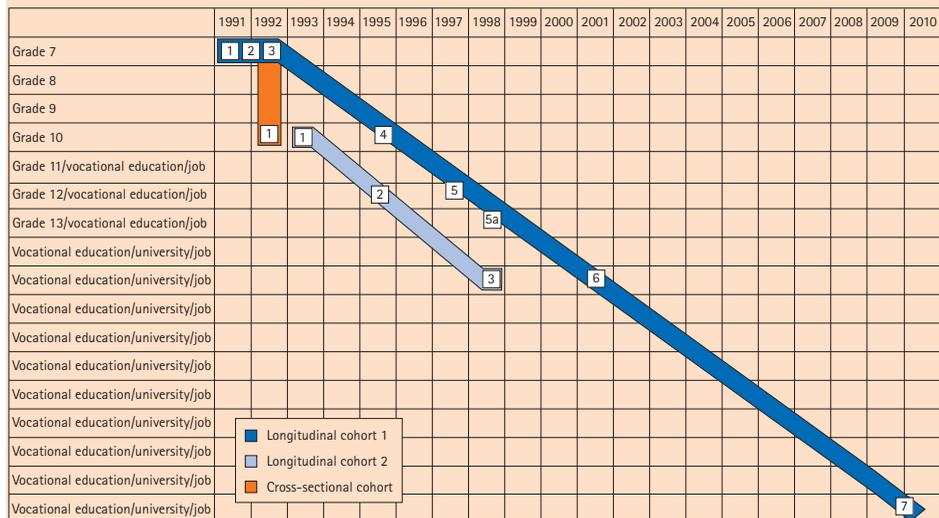
was concluded with the retirement of Jürgen Baumert in mid-2010, the research field is still in flux and far from saturated. Many influential contributions originating in the Center are being followed up by researchers at other institutions. In addition, Jürgen Baumert and his team remain active in this field. The Center's key research projects and large-scale studies have found new homes at different universities across Germany. More specifically, together with Jürgen Baumert, Kai Maaz and his team (including Michael Becker and Marko Neumann) at the University of Potsdam are taking responsibility for the BIJU project. Ulrich Trautwein and his team at the University of Tübingen (including Gabriel Nagy and Kathrin Jonkmann) are in charge of the TOSCA project and the TRAIN study. Ulrich Trautwein will also continue to examine the work on effects of homework assignments and completion. Finally, Oliver Lüdtke, who is now at Humboldt University Berlin, will continue the research program on methodological aspects of assessing contextual effects in student achievement studies.

The BIJU Study—Aims and Data Collection

BIJU has four guiding 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;
- (3) analyzing long-term trajectories of psychosocial development in adolescence and young adulthood;
- (4) analyzing ways of coping with the transition from school to vocational training or university.

Data collection began with a survey of the main cohort (longitudinal cohort 1) in the 1991/92 school year (see Figure 4). 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. A seventh wave of data collection took place in 2009/10. 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. A second longitudinal cohort and a cross-sectional add-on study complement the BIJU data set.



www.biju.mpg.de

Figure 4. Study design of the BIJU project.

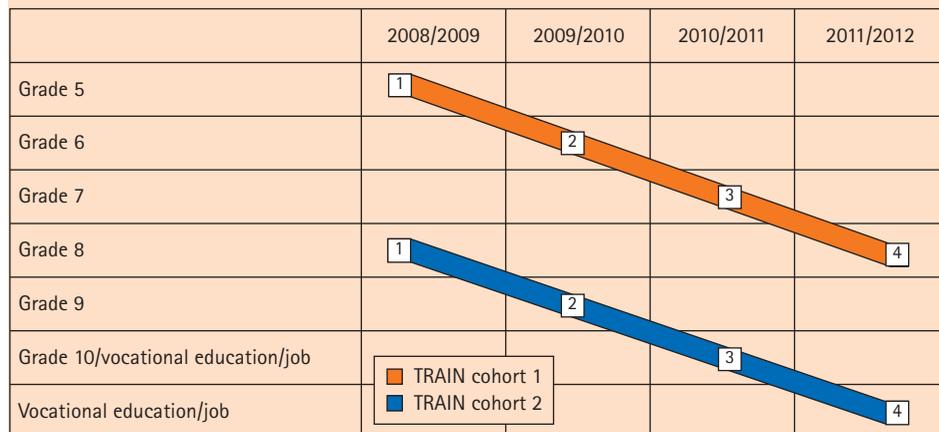
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The TRAIN Study—Aims and Data Collection

The TRAIN (Tradition and Innovation) study investigates students' developmental trajectories and learning gains in the differently structured educational systems of Baden-Wuerttemberg and Saxony. The focus of our analyses is on the lower and intermediate tracks (*Hauptschule* and *Realschule*), which are separate in Baden-Wuerttemberg, but implemented in a combined *Mittelschule* in Saxony.

TRAIN addresses important research questions that prior studies were not able to examine in sufficient detail. Most important, the study investigates the consequences of different forms of ability grouping and the impact of class composition. Moreover, intervention modules are implemented with the aim of identifying effective means of improving the motivation and achievement of at-risk students. In addition, the study analyzes the educational careers of students with specific learning difficulties or behavioral or psychological problems and their influence on the learning and development of their classmates. Data collection began in November of the 2008/09 school year. Participants were some 6,000 grade 5 and grade 8 students in 60 *Hauptschulen* and 24 *Realschulen* in Baden-Wuerttemberg and 22 *Mittelschulen* in Saxony (see Figure 6). Data were also obtained from the students' teachers and parents. The students were administered a comprehensive battery of tests and questionnaires over a 2-day period. The achievement tests covered the academic domains of mathematics, English as a foreign language, and German. Basic cognitive ability, concentration, and career knowledge were also assessed. The questionnaires focused on student motivation, interests, family background, self-concept, psychological problems, learning difficulties, and uptake of additional and remedial instruction. In Saxony, social network data were also obtained. Form tutors were asked about various aspects of their work, and teacher ratings of each student's behavioral problems, participation, and motivation were also obtained in both states.

Data are to be collected annually over a 4-year period (for the grade 5 cohort). We intend to continue monitoring the students of the grade 8 cohort after they have left school.



www.train-studie.de

Figure 6. Study design of the TRAIN project.

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Research Area II: Transitions in the Educational System

The biographies of young people are characterized by a host of transitions. Beyond the biological changes and psychological transitions from childhood to adolescence and adulthood that each individual needs to negotiate, young people have to make several transitions within the educational system, each governed by specific institutional, legal, and societal regulations. These transitions require complex decisions that, in differentiated educational systems, have far-reaching effects on students' educational and vocational biographies. The analysis of transitions has a long tradition within the Center for Educational Research. Research Area II integrates all of the Center's projects and subprojects that deal explicitly with the analysis of transitions at various stages of educational careers, placing a particular focus on family background.

The specific importance of educational transitions in the German school system results from the structure of the educational system. Students in Germany are selected to different secondary tracks at the end of grade 4 or grade 6, when they are about 10 or 12 years of age (Figure 7). There is considerable variation across the German states in terms of the number and quality of these tracks. Although between-school tracking is the major form of achievement differentiation, within-school and between-school differentiation are used concurrently in some states. In addition, some major reforms have been implemented in many German states in the last few years,

with a clear shift toward a two-track system. Nevertheless, the "tripartite" system of *Hauptschule*, *Realschule*, and *Gymnasium* remains the best known in Germany, and most of our data sets were collected when there were still three or more secondary tracks in most German states.

Figure 7 shows a simplified version of the German school system. *Hauptschule* is the academically least demanding track; *Realschule*, the intermediate track; and *Gymnasium*, the college-bound track. *Hauptschule* students, who graduate after grade 9 or grade 10, typically enter the dual system, which combines part-time education at vocational school

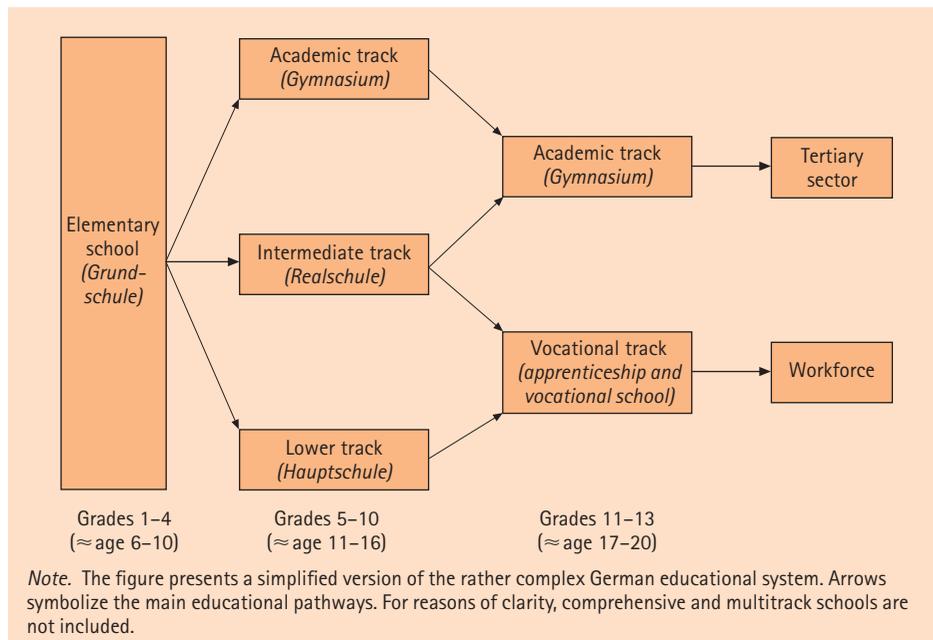


Figure 7. The German educational system.

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with on-the-job training. *Realschule* students graduate after grade 10; most of them also enter the dual system, usually aspiring to more skilled occupations. *Gymnasium* students graduate after grade 12 or grade 13; the final *Gymnasium* examination (*Abitur*) is a requirement for university entrance (Maaz, Neumann, & Trautwein, 2009). Although the educational pathways illustrated are the most common, it is also possible for students to transfer to a higher or lower track at various points in their school careers.

The principle guiding the tracked secondary system is to provide all students with an education commensurate with their aptitudes and needs that allows them to reach their fullest potential. To what extent this strategy succeeds is a recurring question that has been examined widely (e.g., in Research Area I). The findings of this research indicate that the school types of the tracked secondary system represent differential learning and developmental environments and that students in the different school types learn different amounts. The secondary school type attended can thus critically influence the learning trajectories observed.

Academic achievement is the main determinant of the secondary school type attended in all German states. Parents can also influence the transition decision, however, and various systematic (e.g., regional structures) and unsystematic factors (e.g., "measurement errors") may play an additional role. Whether and how students are able to transfer from one track to another during their lower secondary education also depends on various factors (Baumert, Maaz, & Trautwein, 2010a; Maaz, Baumert, Gresch, & McElvany, 2010).

In view of the significance of the transition to the tracked secondary system, the theoretical and practical questions addressed in Research Area II include the following:

- How close is the association between family background and the transition decision? What are the mechanisms underlying this association?
- How permeable is the school system? Which students take advantage of this permeability?

- What role do teachers play at decisive points of transition? How do they approach the difficult diagnostic task of recommending a secondary track?
- Are there undesired reference group effects at points of transition, similar to those known to exist for grading, for example?
- Do students from immigrant families face specific challenges at the transition to secondary education?

The Transition Study: From Elementary to Lower Secondary Education

The Transition study on *The Transition From Elementary to Secondary School: Regional, Social, and Ethnic/Cultural Disparities in Educational Equity* is the first to present nationally representative data on the transition to secondary education, one of the most critical transitions in the educational biography. The Transition study was linked to the *Trends in International Mathematics and Science Study* (TIMSS 2007, Principle Investigator: Wilfried Bos) and the BiSta study, which was conducted to standardize test items for the assessment of educational standards in German and mathematics at elementary level (Principle Investigator: Olaf Köller). The Transition study extended the design of TIMSS 2007 and BiSta to include a parent survey assessing aspects of social background and parental support behavior as well as a survey of elementary teachers. This collaborative approach allowed us to draw on the results of standardized tests in mathematics, science, and German without additional financial costs and to considerably extend the scientific knowledge of how parental intentions, cultural, social, and economic backgrounds, teachers' recommendations, and institutional regulations interact at the transition from primary to secondary school. The study was conducted in 13 German states in the 2006/07 school year. A total of 4,768 students from 227 classes participated, along with their parents and class teachers.

The Transition study takes an interdisciplinary approach that connects questions addressed by educational science, psychology, and sociology. The main objective of the Transition study was to analyze the

formation of parental decisions concerning the transition from elementary to secondary school against the background of the following factors:

- students' achievement and attitudes at elementary school;
- the parental decision-making process as a function of the social, ethnic, and cultural background;
- the secondary track recommended by the elementary school teacher;
- the process of parent–teacher consultation;
- institutional regulations; and
- regional differences in the structure of the secondary system, the cultural environment, and the economic and labor market structure.

The second objective of the study was to analyze how the students and their parents coped with the process of transition.

Primary and Secondary Background Effects at the Transition to Secondary Education

Drawing on Boudon's theoretical model originally developed in the 1970s, Maaz and Nagy (2010) analyzed the effects of social background at the transition to lower secondary education. For the Transition study, Boudon's model was adapted to the German educational system and extended to include factors with particular relevance for the transition from elementary to lower secondary education (grades and teacher recommendations). Maaz and Nagy specified Boudon's definition of primary background effects as social background influences that impact the development of students' competence and consequently affect their grades, the secondary track their teachers recommend, and the track in which they enroll. Secondary background effects, in contrast, are social background

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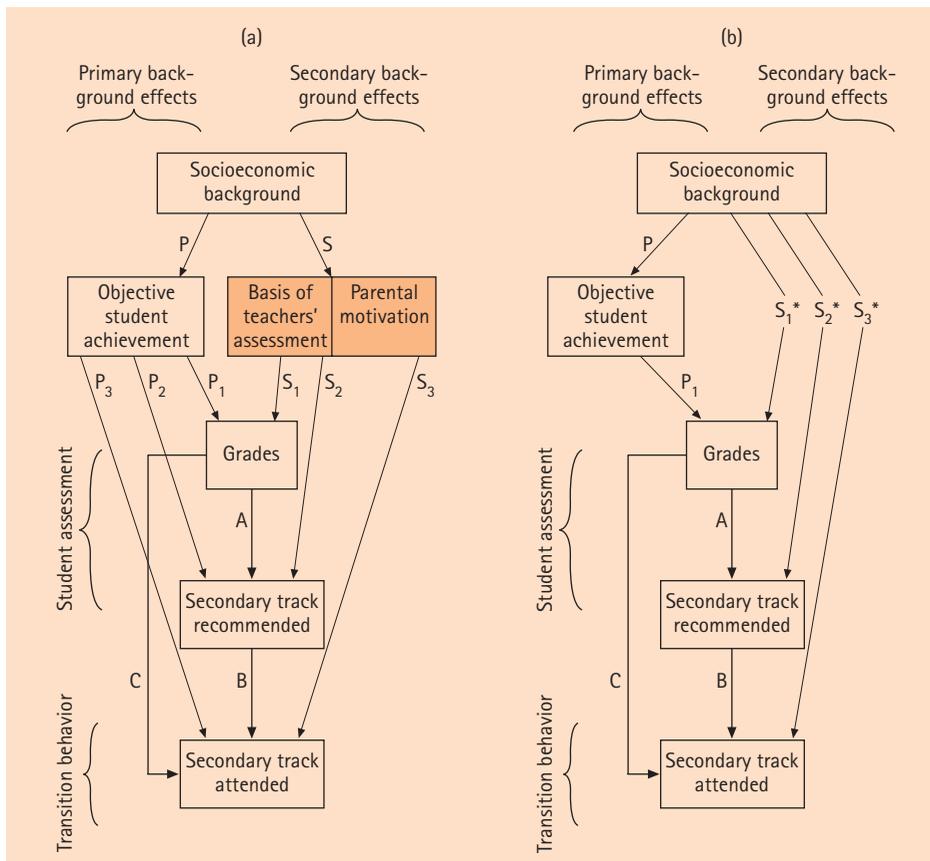


Figure 8. Schematic illustration of the structural model of background effects: (a) full theoretical model and (b) reduced model used by Maaz and Nagy (2010).

Table 1
Detailed Path Diagram of the Path Model Investigated (Standardized Solution): Estimates of Primary and Secondary Background Effects and Total Background Effects (Sum of Primary and Secondary Effects)—Figures in Parentheses Show the Relative Proportions of Primary/Secondary Background Effects to Total Background Effects

	Primary background effects		Secondary background effects		Total background effects
<i>Student assessment (PBE-A/SBE-A)</i>					
German	.22	(0.60)	.15	(0.40)	.37
Mathematics	.23	(0.67)	.11	(0.33)	.35
General studies	.19	(0.53)	.17	(0.47)	.36
<i>Student assessment (PBE-TR/SBE-TR)</i>					
Carried over PBE-A/SBE-A	.24	(0.63)	.14	(0.37)	.37
Incremental	–	(–)	.11	(–)	.11
Total	.24	(0.49)	.25	(0.51)	.48
<i>Transition behavior (PBE-TB/SBE-TB)</i>					
Carried over PBE-A/SBE-A	.12	(0.65)	.07	(0.35)	.19
Carried over PBE-TR/SBE-TR	.09	(0.49)	.09	(0.51)	.18
Incremental	–	(–)	.14	(–)	.14
Total	.21	(0.41)	.30	(0.59)	.51

Note. PBE-A: primary background effect of assessment; SBE-A: secondary background effect of assessment; PBE-TR: primary background effect of track recommendation; SBE-TR: secondary background effect of track recommendation; PBE-TB: primary background effect of transition behavior; SBE-TB: secondary background effect of transition behavior.

influences resulting from factors other than students' academic achievement—for example, from social differences in educational expectations or behaviors at the transition to secondary education. In contrast to primary effects, these secondary effects are incompatible with meritocratic beliefs about students' educational outcomes and prospects.

Maaz and Nagy (2010) sought to gauge the influences of social background on grading, the secondary track recommended, and the track in which students actually enrolled. Moreover, they sought to disentangle primary and secondary effects of social background and thus to identify potential points of intervention for reducing inequalities of opportunity in the German educational system (see Figure 8).

In line with previous findings, the data showed that socioeconomic background affected student grades, the secondary track recommended, and the secondary track attended, having the lowest absolute effect on grades and the highest on secondary track

attended. Both primary and secondary effects of social background were found for all three outcomes under consideration. For grades, the relative proportion of primary effects was larger than that of secondary effects. For secondary track recommended, both effects were of approximately the same size. For secondary track attended, however, secondary effects outweighed primary effects.

Moreover, about half of this secondary effect on transition behavior was attributable to a carry-over of the preceding effects on grades and secondary track recommended (see Table 1). The other half of the effect resulted from the parents' final decision on a secondary track. In other words, even if the secondary effects involved in teachers' assessments of their students were fully eliminated, students from socially privileged families would still have higher chances of attending an academic-track school than children from less privileged families, even if their achievement was identical (see also Baumert & Maaz, 2010a).

Immigration

The results of the PISA study confirmed that students from immigrant families do less well at school and leave education with lower qualifications than their German peers. Whereas PISA examined student achievement and educational opportunities toward the end of compulsory education, Gresch and Becker (2010) investigated the relationship between immigration background and access to the academic track at the end of elementary schooling.

Like Maaz and Nagy (2010), Gresch and Becker (2010) drew on Boudon's theoretical model that distinguishes between primary and secondary effects of social background. Immigration-specific primary effects may result, for example, from language difficulties that make it harder for children from immigrant families to follow instruction, leading to lower achievement levels. In contrast, secondary—that is, achievement-independent—effects of immigration background are in operation when, for example, immigrant students move to a lower secondary school track than their German peers despite comparable achievement levels.

Because previous research has shown that the educational behavior of immigrant groups

may differ depending on their specific social and cultural background, the Transition study focused on the two largest groups of immigrants in Germany: students from Turkish families and the children of ethnic German repatriates. Very few previous studies in Germany have allowed immigrant groups to be differentiated, and barely any empirical findings were previously available on the children of ethnic German repatriates.

The results (see Figure 9) showed that children from immigrant families were, in general, less likely to attend an academic-track *Gymnasium*, but that this difference was primarily attributable to the lower socioeconomic status of their families. When achievement levels were comparable, this negative background effect was reversed, with students from immigrant families having greater chances of attending *Gymnasium* than their German peers. This pattern of results was particularly pronounced for students with a Turkish background. This finding can be interpreted as a *positive* secondary effect of immigration background. It is explained by the fact that immigrant families are often particularly keen for their children to attend the academic track. However, few immigrant children live up to these expecta-

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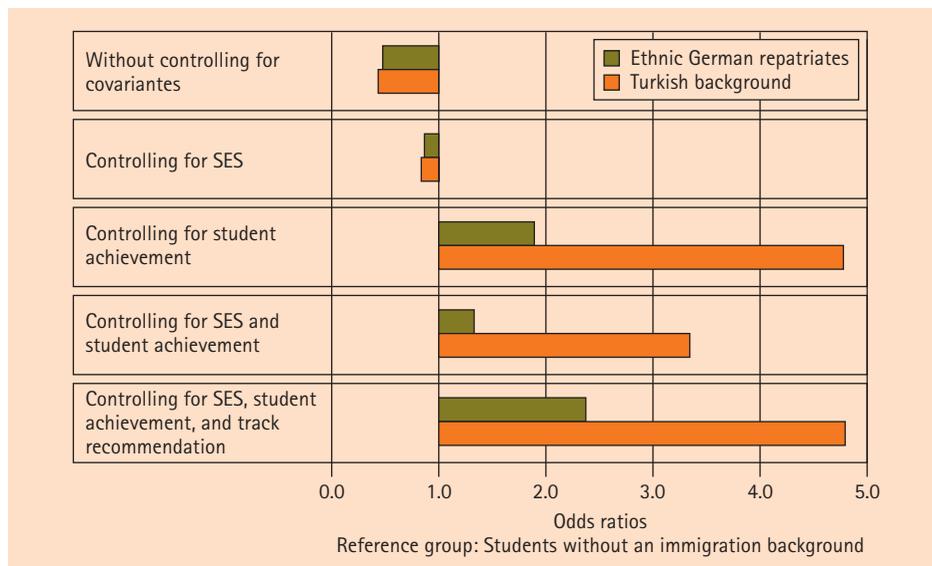


Figure 9. Logistical regression of transition behavior on immigration background, socioeconomic status (SES), standardized test scores, grades, and track recommendation.

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tions, as their achievement levels are typically not high enough.

In summary, student achievement is a key factor in the lower participation of immigrant children in the academic track of the German secondary school system. Our findings indicate that the causes of differential participation are not located in the transition process itself, but take effect prior to this transition. Measures such as language development programs in preschool and elementary school are therefore needed to better equip children from immigrant families for school learning. Only then will immigrants and their children have a realistic chance of achieving their high educational goals.

Institutional Effects

Gresch, Baumert, and Maaz (2010) investigated how institutional regulations governing the transition process influenced parental decision making. One key factor in the transition process is the secondary track recommended by the elementary school on the basis of individual student aptitude. The degree to which this recommendation is binding varies considerably across states. In some states, parents are able to enroll their child in the secondary track of their choice, even if a less challenging track was recommended. In other states, students whose parents wish to enroll them in a higher track than that recommended are required to pass a formal examination as evidence of their suitability for that track. In the former case, the degree of bindingness is low; in the latter, it is high and linked to an examination (Füssel, Gresch, Baumert, & Maaz, 2010; Kropf, Gresch, & Maaz, 2010). Whether or not these differences in the degree of bindingness of the tracking recommendation have differential effects on parents' decisions is a contentious issue in the literature. Gresch et al. (2010) were the first to systematically address the relationship between the bindingness of the recommendation and social selectivity at the transition to secondary education, drawing on data from all states in which students transfer to secondary education at the end of grade 4. The first finding to emerge from the analyses is also apparent from the official statistics.

In those states in which the elementary school's recommendation is binding, mean rates of transfer to the academic track are considerably lower than in the other states. However, this effect is not attributable—as one might be tempted to infer from the official statistics—to fewer students being recommended for the *Gymnasium* track in those states. In fact, the opposite seems to be the case: Our data indicate that elementary teachers in states in which recommendations are binding are more liberal in giving recommendations for the *Gymnasium* track. Neither is the effect attributable to differences in the social structure of parents with school-aged children in the two groups of states. The difference in transition behavior persisted even when socioeconomic background and track recommendation were controlled. A second finding adds to this picture: The bindingness of the recommendation does not regulate transitions to the *Gymnasium* track that are not in line with teachers' recommendations either. In other words, the threat of an additional examination does not have a generally deterrent effect on parents who want to send their children to a *Gymnasium* even without a recommendation.

Thus, the observable differences between the two groups of states in educational participation at *Gymnasium* are not attributable to differences in elementary school teachers' recommendation practices, in the social structure of the student population, or even in the institutional regulations governing the transition to secondary education.

A second set of analyses examined the relationship between the bindingness of the tracking recommendation and socially determined differences in parental decision making. Consistent with the results of Maaz and Nagy (2010), the data showed that social background has a substantial influence on the decision-making process—even when the track recommendation is controlled. The chances of a student from a highly privileged background attending a *Gymnasium* were more than 60% higher than those of a student from a middle-class family, even if both students had been recommended for the same track. This finding is not surprising.

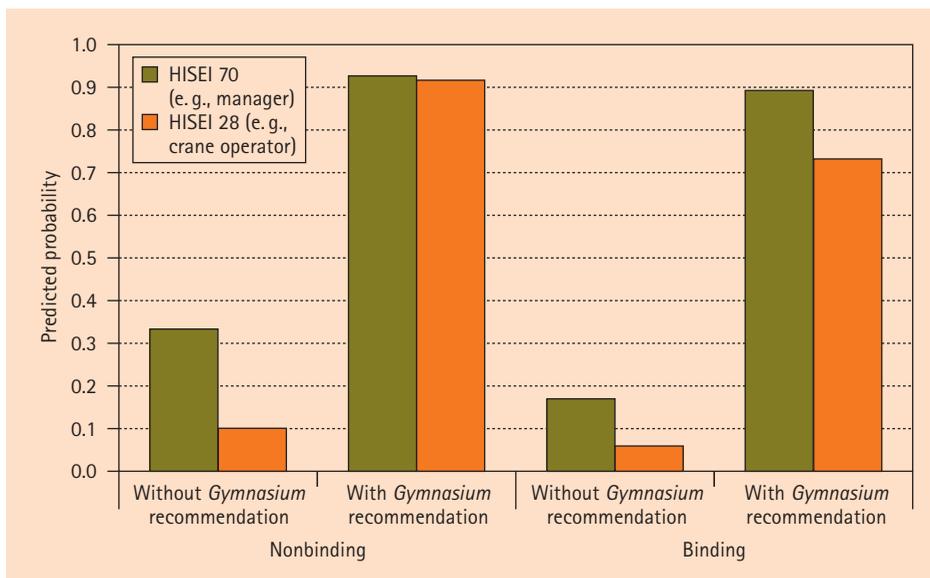


Figure 10. Probability of transferring to a *Gymnasium* depending on the track recommendation received, whether or not it is binding, and social background.

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What is notable, however, is that the effect of social background is particularly marked for students who were not recommended for *Gymnasium*—but only in states where parents are free to choose a secondary track (see Figure 10). This pattern of results suggests that increasing the bindingness of elementary school recommendation, while stipulating that students wishing to attend a secondary track higher than that recommended must first pass an objective examination, can diminish social disparities in educational behavior.

Parental Decisions: Testing the Extended Expectancy–Value Model

Almost every sixth *Gymnasium* student was not recommended for *Gymnasium* by his or her elementary school, and almost every tenth student at other school types was in fact recommended for *Gymnasium*. Which factors cause parents to decide for or against a certain school type? In various theoretical approaches from psychology and sociology, values and expectancies of success have been identified as playing a decisive role in the formation of educational decisions. However, it remains unclear how exactly parents arrive at

these decisions. Using data from the Transition study, Jonkmann, Maaz, McElvany, and Baumert (2010) for the first time investigated all factors theoretically predicted to impact parental decisions in a single empirical study. The study drew on the extended expectancy–value model of Eccles and colleagues, which has already been used to predict educational decisions, such as the choice of major. The model predicts that parents will decide on a *Gymnasium* if they are confident that their child will be able to cope with the demands of this track. The value that parents attribute to a *Gymnasium* education makes an equally important contribution to their decision (see Figure 11).

Four aspects of the value component are distinguished. The status maintenance motive reflects the importance of the *Abitur* qualification in fulfilling parents' expectations that their child will do at least as well as they have in the world of work. Further, the value accorded to a broad general education, the perceived utility of the *Abitur* qualification for the child's future career, and the costs of staying in education for longer all feed into the value that parents place on their children attending *Gymnasium*.

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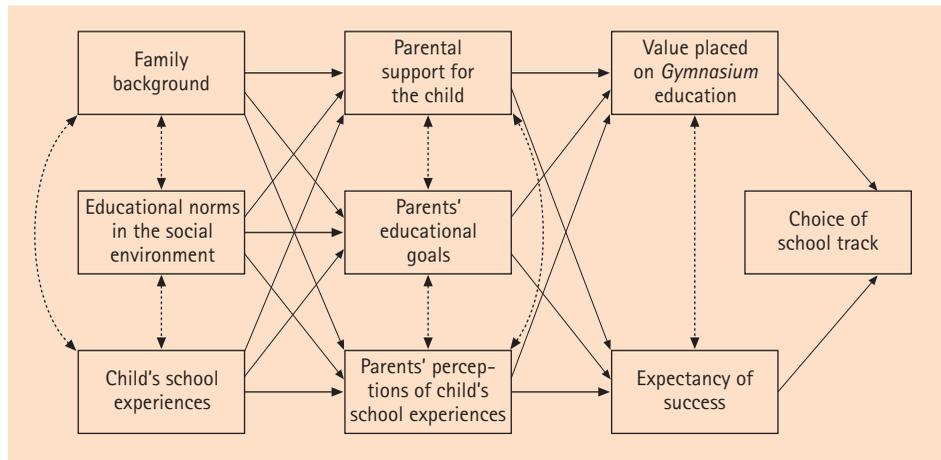


Figure 11. The extended expectancy-value model for parental decisions on the choice of secondary school track.

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According to the Eccles model, parents' expectancies and values are determined by their evaluations of their child's academic achievement, the mid- and long-term educational goals they have for their child, and their confidence in being able to support their child. These more psychological characteristics in turn mediate the effects of the more sociological characteristics of the family's socioeconomic and cultural background, the social environment, and the child's educational experiences to date.

Jonkmann, Maaz, McElvany, & Baumert (2010) compared parents who had enrolled their child in a *Gymnasium* without a recommendation with parents who had followed the recommendation of the elementary school, and with parents who had chosen a different school type although their children were recommended for *Gymnasium*. The results were largely in line with the predictions of the model. If *Gymnasium* was "the norm" in the family's social environment, parents were more likely to send their child to a *Gymnasium* even without a recommendation. These children reported somewhat more pressure to perform and psychosomatic complaints in elementary school than their future classmates who were recommended for *Gymnasium*. Even without a *Gymnasium* recommendation, the likelihood of a child attending *Gymnasium* increased if the parents considered the child to be underchal-

lenged at elementary school or regarded the *Abitur* qualification as important for status maintenance. For parents who opted for *Gymnasium* without a recommendation, the perceived utility of the *Abitur* qualification for their child's future career was particularly high. However, all parent groups attributed high importance to a broad general education; this characteristic did not differentiate between the study groups. Likewise, financial considerations did not impact school choice. As predicted by the model, parents' expectancies of success also played an important role in the choice of the secondary school track. Parents who enrolled their child in a *Gymnasium* were more confident in their children's success than other parents—even if the elementary school had advised against a *Gymnasium*. Family socioeconomic background, in contrast, was almost irrelevant to the transition decision when differences in parents' expectancies, values, and beliefs were controlled.

In sum, the results of this study showed that parents differ in the way they respond to the tracking recommendation made by the elementary school and that these differences can be effectively predicted by the extended expectancy-value model. The model can thus help to further the understanding of how parental deliberations and decisions contribute to the emergence of social inequality at the transition to secondary education.

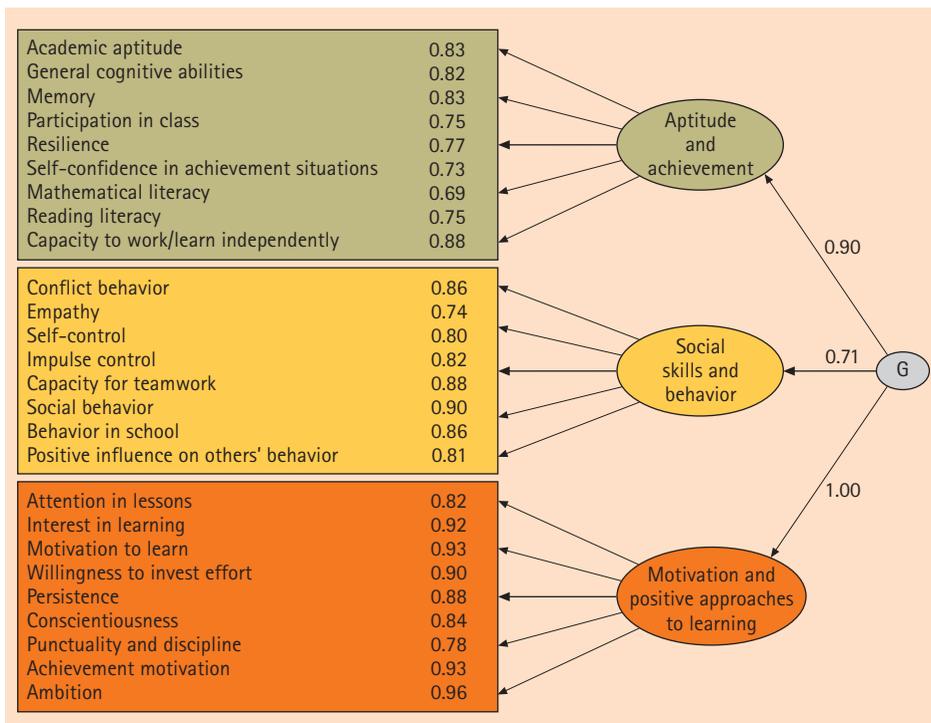


Figure 12. Teachers' assessments of individual student characteristics at the transition to secondary education: Factor structure.

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Teachers' Assessments of Relevant Student Characteristics

Grades are not everything—certainly not in the secondary tracking recommendations that elementary teachers make for their students at the end of elementary schooling. Apart from the grades attained, teachers' decisions are informed by their evaluations of the students' potential for learning and development. The teacher's role in recommending a secondary track for each individual student is thus complex: They need to both diagnose students' current abilities and predict their future development.

In recent years, teachers' diagnostic skills have been the subject of broad policy discussion. On the one hand, teachers are widely considered to have good diagnostic skills; on the other hand, studies have revealed a wide range in their diagnostic abilities. The *Progress in International Reading Literacy Study* (PIRLS) recently showed that the correlations between teachers' secondary track recommendations and students' scores on stan-

dardized assessments of spelling and reading comprehension were only moderate. However, this discussion often overlooks the fact that teachers take a variety of student characteristics into consideration when recommending a secondary track—these include aptitude, motivation, and participation in class, as well as conscientiousness and capacity for teamwork. Empirical studies examining these individual assessments at the transition to secondary education are rare, however. Anders, McElvany, and Baumert (2010) examined the specificity of teacher assessments of individual student characteristics. They further examined the relationship of teacher assessments of various student characteristics with students' sex, socioeconomic status, and immigration status, as well as their grades and the secondary track recommended. To this end, 231 teachers were asked to rate each of their students on 30 school- and instruction-related characteristics. Ratings were obtained for a total of 4,101 students, who were in grade 4 of elementary school at the time of

Key Reference

Anders, Y., McElvany, N., & Baumert, J. (2010). Die Einschätzung lernrelevanter Schülermerkmale zum Zeitpunkt des Übergangs von der Grundschule auf die weiterführende Schule: Wie differenziert urteilen Lehrkräfte? In K. Maaz, J. Baumert, C. Gresch, & N. McElvany (Eds.), *Der Übergang von der Grundschule in die weiterführende Schule: Leistungsgerechtigkeit und regionale, soziale und ethnisch-kulturelle Disparitäten* (pp. 313–330). Bonn: BMBF, Referat Bildungsforschung.

Table 2
Predicting the Secondary School Recommended: Results of Regression Models

	Dependent variable: Tracking recommendation Gymnasium			
	Model 1		Model 2	
	B	SE(B)	B	SE(B)
Aptitude and achievement	0.75**	0.07	0.29**	0.08
Social skills and behavior	-0.14**	0.05	-0.07**	0.06
Motivation and positive approaches to learning	0.20**	0.07	0.10**	0.08
Mid-year grade mathematics			-0.29**	0.06
Mid-year grade German			-0.39**	0.07
R^2	0.72		0.83	
** $p < 0.01$.				

the assessment. The participating teachers were also asked which secondary track they had recommended for each student. The results indicate that teachers generate an overall picture of each of their students, summarizing numerous individual characteristics to three overarching domains: *aptitude and achievement*, *social skills and behavior*, and *motivation and positive approaches to learning* (see Figure 12). The number of factors on which teachers base their assessments of their students is therefore limited. The study further examined the association of teacher assessments of relevant student characteristics with students' sex, socioeconomic status, and immigration status. It emerged that girls' *social skills and behavior* were rated higher than those of boys. Girls were also rated somewhat higher in the domain of *motivation and positive approaches to learning*. Moderate relations were found between family socioeconomic status and the domains *aptitude and achievement* and *motivation and positive approaches to learning*. Correlations with students' immigration status were low, however. A further finding was that, in total, the student characteristics in the three domains explained more than half of the differences observed in German and mathematics grades. The domain of *aptitude and achievement*

proved to be more important here than the other two domains. The Transition study thus provided empirical evidence that elementary teachers' recommendations of a secondary school track are based not only on students' grades but also on teachers' assessments of other relevant student characteristics (see Table 2).

TOSCA

There is no doubt that the transition to lower secondary education is one of the most important transitions in a student's educational career. However, later transitions—to upper secondary education and the tertiary sector, in particular—become increasingly important as educational pathways are opened up, allowing students to reconsider and revise earlier decisions (Maaz, Watermann, & Köller, 2009). To date, comparatively few studies have investigated these later transitions. The TOSCA study now provides a broad database allowing the transitions to upper secondary education and the tertiary sector to be thoroughly analyzed.

Vocational Interests

Vocational interests are regarded as strong determinants of educational and occupational decisions. However, it is clear that the process of educational and occupational specializa-

Table 3
Holland's Interest Domains (RIASEC) and Preferred Activities

<i>Interest domains</i>	<i>Preferred activities</i>
Realistic (R)	Activities that involve physical exertion and coordination and that produce concrete results.
Investigative (I)	Activities involving the symbolic and systematic investigation of physical, biological, or cultural phenomena.
Artistic (A)	Open unstructured activities involving artistic self-expression and creativity.
Social (S)	Activities that involve working with people to inform, help, or otherwise be of service to them.
Enterprising (E)	Activities that involve influencing, managing, or leading others.
Conventional (C)	Systematic activities requiring attention to accuracy and detail.

tion begins well before the clearly visible transition to vocational or higher education. First steps toward occupational specialization can be seen in the choices that students make at school—for example, in the advanced *Abitur* courses they choose or in the decision to enroll in *Gymnasium* schools specializing in certain fields at upper secondary level. These choices are closely related to later transitions to occupational training and higher education.

To date, the role of vocational interests in early phases of education (e. g., at lower secondary school) has barely been investigated. In particular, prospective studies investigating the relationship between vocational interests and educational decisions are scarce. The available studies point to substantial group differences—which are consistent with theoretical expectations—between upper secondary students enrolled in *Gymnasium* schools with differing specializations. However, these findings provide only indirect evidence that vocational interests guide the transition to upper secondary education through self-selection processes—it is equally possible that these differences are a function of socialization effects occurring at upper secondary level.

Against this background, Nagy and Husemann (2010) examined whether the structure of vocational interests differs before and after the transition to upper secondary education; the relationship between vocational interests

measured in lower secondary education and subsequent transition decisions; and to what extent differences in the interests of students enrolled in *Gymnasium* schools with differing specializations are attributable to self-selection processes or to socialization processes. The theoretical framework for this study was provided by John Holland's occupational choice theory. The centerpiece of the theory is a taxonomy of vocational interests that is distinguished by both its parsimony and the breadth of its applicability. Holland's model of vocational interests specifies six interest domains: *realistic* (R), *investigative* (I), *artistic* (A), *social* (S), *enterprising* (E), and *conventional* (C). Characteristic activities can be assigned to each of the six domains (see Table 3 for examples).

According to the calculus hypothesis, these six interest domains can be represented in a two-dimensional space by arranging them in a circle with the order R, I, A, S, E, and C, with similarity between the domains determining their relative position and proximity: Domains are located next to those to which they are most similar and opposite those to which they are most dissimilar. The strong version of the calculus hypothesis assumes that the structure of vocational interests can be represented by a perfect circle with equal distances between domains, whereas the weaker version does not expect the distances to be invariant. The structural model of vocational interests has important implications for the prototypi-

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Watermann, R., & Maaz, K. (2010). Soziale Herkunft und Hochschulzugang—eine Überprüfung der Theorie des geplanten Verhaltens. In W. Bos, E. Klieme, & O. Köller (Eds.), *Schulische Lerngelegenheiten und Kompetenzentwicklung: Festschrift für Jürgen Baumert* (pp. 311–330). Münster: Waxmann

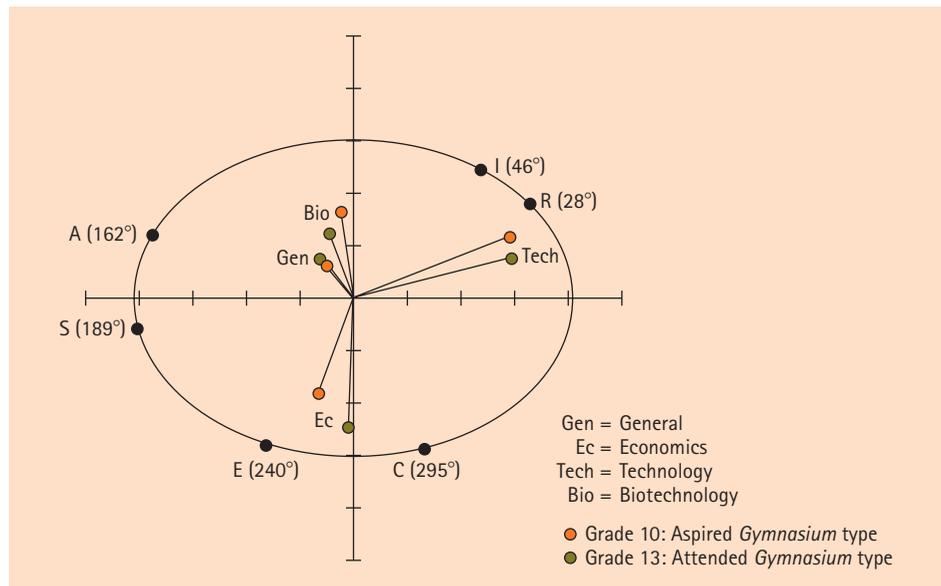


Figure 13. Elliptical structure of vocational interests of students aspiring to attend and attending specific *Gymnasium* types at upper secondary level in Baden-Wuerttemberg; mean interest profiles are represented as vectors.

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cal shape of individual interest profiles. The calculus hypothesis implies that individuals tend to structure their interests according to a circular similarity structure (e.g., Nagy, Marsh, Lüdtke, & Trautwein, 2009). Nagy and Husemann (2010) based their analysis on two data sets obtained in the context of the TOSCA study: one from a sample of students at the end of grade 10 (TOSCA-10) and one from a sample of *Abitur* students at the end of grade 13 (TOSCA-2006). Interest structures were investigated using a specially developed factor analytic model that is capable of describing both the strong and the weak versions of the calculus hypothesis. In contrast to established approaches, which are only able to describe circular structures, this model also allows elliptical similarity configurations to be described. This model was applied simultaneously to four subgroups of students formed by the cross-classification of time of assessment (grade 10 vs. grade 13) and lower secondary school type attended (*Realschule* vs. *Gymnasium*). The results can be summarized as follows. First, for all subgroups, an elliptical similarity configuration showed a good fit to the data and was consistent with the expectations of

the calculus hypothesis. Second, the central parameters of the measurement model proved to be invariant across groups, meaning that the conditions for profile comparisons were satisfied. Third, the groups compared in the first step differed only in terms of their interest level, with lower interest levels in the older TOSCA-2006 subgroups. Figure 13 illustrates the interest structures observed in the subgroups examined. As shown, the sequence of interest domains (RIASEC) was in line with theoretical expectations. Nagy and Husemann (2010) further compared the interest profiles of *Realschule* graduates in TOSCA-10 with an earlier cohort of *Realschule* students in TOSCA-2006, who aspired to, or had already attended, the same types of *Gymnasium*. For each type of *Gymnasium*, they compared the key characteristics of the vocational interest profile (level, orientation, and differentiation) of the two student cohorts. The results again documented a decreasing trend in the profile level, reflecting the effect of age. There were also some significant differences in profile orientations, although their magnitude was small. The same applied to profile differentiation, where again only small effects were observed.

The interest profiles found for the various types of *Gymnasium* school are represented as vectors in Figure 13. The direction of the vectors represents the orientation of the mean interest profiles (i. e., the domains in which interests are highest). Their length is proportional to the differentiation of the mean interest profile. Long vectors indicate highly accentuated profiles (i. e., strong relations with transition decision), whereas short vectors represent less accentuated profiles (i. e., weak relations with transition decision). Three main conclusions can be drawn from Figure 13. First, as expected, an association was found between the orientation of interest profiles and the content focus of the *Gymnasium* in question. Second, the strength of the association of profiles with transition decisions differed across the various options. Third, the profile vectors of the groups of students aspiring to attend and attending the different *Gymnasium* types barely differed from one another.

Primary and Secondary Background Effects on Future Study Intentions and Access to Higher Education

The longitudinal TOSCA data also allow us to disentangle primary and secondary background effects at the transition to higher education. Watermann and Maaz (2010) examined the effects of primary and secondary disparities on both future study intentions and access to higher education. Because the broad base of achievement data available covers both students' abilities and qualifications earned, the TOSCA database may provide more valid estimates of the secondary background effect than have been possible in other studies.

The analyses showed that, even within the relatively homogeneous group of *Abitur* students at general *Gymnasium* schools in Baden-Wuerttemberg, social background effects operate at entry to higher education: Both social class and parental educational qualifications contributed significantly to the prediction of access to higher education. Thus, the data confirmed that the transition to higher education is another threshold at which *Abitur* students at general *Gymna-*

sium schools—who are already a positively selected group—undergo social selection. As expected, controlling for achievement-related variables substantially improved the prediction, with achievement playing a far greater role than family structure characteristics. As the effects of family structure characteristics decreased only slightly when achievement was controlled, it seems that primary background effects are very low, whereas secondary background effects play a greater role. However, it is important to see the findings of the rather low magnitude of primary and secondary effects of social background against the background that these analyses focused on students in the upper secondary level of general *Gymnasium* schools rather than encompassing the whole age cohort. Moreover, in contrast to the analyses of study intentions, the analyses of access to higher education revealed mathematical ability to play a more important role than qualifications or social background variables. These were the first empirical findings to show that student abilities outweigh their qualifications at the transfer to higher education.

The secondary social background effect was fully explained by a mediation model developed on the basis of the theory of planned behavior. Moreover, the variables specified in the theory of planned behavior proved to go far beyond the role of mediators: Inclusion of the variables (without control for future study intentions) led to a considerable improvement in model fit. Subjective norms were best able to discriminate between those who entered higher education and those who did not. Finally, when study intentions were controlled, the model estimates for subjective norms had an independent and thus direct effect on access to higher education.

These findings show that the social environment—as a psychological environment—is important for both the formation of study intentions and the maintenance or revision of those intentions. Moreover, subjective norms largely mediated the secondary background effect. The psychological variable of perceived behavioral control had no direct effect on access to higher education. *Abitur* grade and mathematical ability had relatively robust

Key Reference

Maaz, K., Baumert, J., Gresch, C., & McElvany, M. (Eds.). (2010). *Der Übergang von der Grundschule in die weiterführende Schule: Leistungsgerechtigkeit und regionale, soziale und ethnisch-kulturelle Disparitäten*. Bonn: BMBF, Referat Bildungsforschung.

effects, indicating that the objective resources or opportunities associated with these characteristics facilitate access to higher education. These findings—as well as the only moderate relationship found between study intentions and access to higher education—show that analyses focusing on one aspect or the other provide only an incomplete picture of the decision-making process.

Looking Back and Ahead

Our studies on the all-important transitions to secondary, vocational, and higher education have consistently shown that family background has a profound effect on educational outcomes. Moreover, the available studies have provided increasingly sophisticated insights into the educational decision processes that underlie these social inequalities and into the role of institutional and regional factors at points of transition. The results of the studies are increasingly informing education policy decision making and reforms. However, little is yet known about the effects of the reforms implemented.

Jürgen Baumert and his team will continue to examine how educational decisions are made and how they are affected by individual, institutional, and structural factors. 2010 saw the initiation of the Berlin study, a new large-scale transition study to be conducted together with Kai Maaz and his team (including Michael Becker and Marko Neumann) at the University of Potsdam and Olaf Köller at the Leibniz Institute for Science and Mathematics Education (IPN). The study was commissioned by the Berlin state government to examine the effects of broad structural reforms of the secondary system that have recently been implemented in Berlin, with profound implications for the transition to secondary education.

Instead of four types of secondary school, the Berlin secondary school system has—since the 2009/10 school year—implemented only two secondary school types: the academic-track *Gymnasium* and the new “integrated secondary school,” which combines the previous *Hauptschule*, *Realschule*, and comprehensive tracks and offers all school-leaving qualifications up to the *Abitur*. Another change con-

cerns the choice of secondary school, which was previously determined largely by catchment areas. Parents are now, in principle, able to choose from all schools in the city, provided that places are available. If demand for places at a school exceeds supply, the school itself decides on the allocation of the majority of its places (60%). A further third of the available places are allocated by lottery; the rest are reserved for hardship cases. The underlying objective of the reforms is to ensure that all students reach their full academic potential and to considerably weaken the link between educational achievement and family background.

Objectives and Design of the Berlin Study

The Berlin study was designed to evaluate the new procedures for transition to secondary education and to investigate the effects of the recent structural reforms in various domains:

- student achievement levels and reduction in the proportion of at-risk students at the end of compulsory schooling;
- effects of the structural reforms on transitions to upper secondary education at *Gymnasium*, vocational training, and higher education;
- the relationship between family background and educational outcomes (educational transitions and student abilities);
- the strength of the link between the school type attended and the qualifications awarded.

A longitudinal multicohort design will be used to evaluate whether the reforms are achieving their stated objectives. Cohort 1 was drawn from the first cohort of students to transfer to secondary education under the new procedures. Cohort 1 comprises some 3,300 students from approximately 180 elementary school classes in Berlin. These students will be assessed at the end of grade 6 in the 2010/11 school year; their progress after transition to secondary education will be tracked on to grade 10. The parents and teachers of the participating students will also be included in the study. A cohort of Berlin students assessed between 2003 and 2005—that is, prior to the reforms—in the context of the Element study

provides the control group for Cohort 1. The Transition study (Maaz, Baumert, Gresch, & McElvany, 2010) will also provide reference data. The instruments administered to Cohort 1 will be aligned with those used in the Element and Transition studies. A first parent survey was conducted in December 2010; the main study will be conducted in elementary schools in May/June 2011. First results for Cohort 1 will be reported in 2012. Moreover, two cohorts of grade 9 to grade 12 students will be investigated, one of which

was educated in the old system and the other in the new system. The students will be assessed in grade 9 and surveyed at several points in their educational careers, with questions focusing on the transition to upper secondary education or vocational training as well as students' aspirations for higher education. The parents and teachers of these students will also be surveyed. First findings on these two student cohorts will be available in 2015.

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 (predoctoral fellow)

Research Area III: Reading Literacy and Language Skills

Introduction and Project Overview

Research Area III examines students' reading literacy and language skills. Using longitudinal, cross-sectional, and experimental approaches, we investigate how these skills develop and how they can be effectively assessed and promoted. Reading literacy is one of the core competencies required in school education, vocational training, and working and private life. Indeed, written language, whether in print or on the computer screen, is probably the most important medium for communicating information. Yet large-scale assessment studies such as PISA have revealed alarming interindividual differences in reading proficiency in all phases of reading development, with substantial numbers of students failing to reach minimum proficiency levels. Accordingly, many students in German secondary schools are unable to comprehend texts on a deeper level; their understanding is limited to simple information retrieval. This applies particularly to students from immigrant families or families with low socioeconomic status. One major focus of our research, which covers all important stages of reading development from elementary to secondary education, is therefore on the determinants of reading development and its promotion in disadvantaged students.

In 2009 and 2010, work in Research Area III focused on four main projects, each examining different aspects in the development of reading proficiency:

(1) The development of reading proficiency from grade 3 to grade 6 and its individual and social predictors were examined in the *Berlin Longitudinal Reading Study* (LESEN 3–6). In this phase of the project, particular attention was paid to reading motivation and to students with immigrant backgrounds.

(2) Complementary projects addressed the effective promotion of reading literacy. These projects include a meta-analysis of the effectiveness of family literacy programs, which was conducted as an international cooperation project, and the development of a questionnaire to assess teacher competence in the area of reading literacy.

(3) The *Text–Picture Integration* (BiTe) project, conducted in cooperation with the University of Landau and funded by the German Research Foundation (DFG), was initiated in

2007 to examine how students develop the ability to integrate text- and picture-based information with their teachers' guidance. This project was in its second phase in 2009 and 2010.

(4) At present, the assessment of reading proficiency is only loosely grounded in cognitive psychology and psycholinguistics. The *Cognitive Language Assessment* (CLAss) project aims to clarify the relationship between reading proficiency tests and the cognitive processes specific to reading.

Berlin Longitudinal Reading Study

Overview

Despite the vital importance of reading for educational, professional, and day-to-day life, recent assessment studies have repeatedly identified serious deficiencies in student reading literacy in Germany. Moreover, students' reading motivation seems to decrease with age. Apart from being a valued resource in its own right, intrinsic reading motivation is

Berlin Longitudinal Reading Study—Data Collection

- 772 students
- 33 participating whole classes
- Elementary schools in Berlin
- Study period: end of grade 3 (basic reading skills usually acquired) to end of grade 6 (transition to secondary school)
- Student, teacher, and parent questionnaires; student reading assessments

positively related to reading performance. In the *Berlin Longitudinal Reading Study* (LESEN 3–6), we have therefore investigated the development of reading comprehension and reading motivation from grade 3 to grade 6, analyzing their complex mutual influences from both a cross-sectional and a longitudinal perspective. Family background has also been identified as an important factor for influencing reading proficiency, with both immigrant background and low socioeconomic status emerging to be associated with lower performance levels. In 2009 and 2010, we therefore investigated (1) the role of intrinsic and extrinsic reading motivation, (2) the effects of mismatch between the home language and the language of instruction on immigrant students' reading acquisition, and (3) the unique and shared variance explained by psychological and sociological constructs when predicting reading literacy.

The Role of Intrinsic and Extrinsic Reading Motivation

One in-depth research focus was on the longitudinal relationships of intrinsic and extrinsic motivation with reading literacy development. In particular, we (a) investigated reading amount as a mediator between motivation and reading literacy and (b) probed for bidirectional relationships between reading motivation and reading literacy, controlling for previous reading literacy (Becker, McElvany, & Kortenbruck, 2010). Structural equation models with latent variables showed that the relationship between intrinsic reading motivation and later reading literacy was mediated by reading amount, but not when previous reading literacy was included in the model. A bidirectional relationship was found between extrinsic reading motivation and reading literacy: Grade 3 reading literacy negatively predicted extrinsic reading motivation in grade 4, which, in turn, negatively predicted reading literacy in grade 6. These findings are of high relevance for practice and research, especially in calling attention to how educators and parents articulate reading-related expectations and to the detrimental impact of extrinsic motivation on the development of reading literacy. In

cooperation with Ana Taboada (George Mason University, USA), we further examined the important role that extensive reading plays for L2 learners (Taboada & McElvany, 2009), thus linking this line of research with our second research focus on the effects of family and cultural background.

The Role of Family Background and Effects of Mismatch Between School and Home Language on Immigrant Students' Reading Acquisition

The role of family background has been one of the focal points of our research since the beginning of the *Berlin Longitudinal Reading Study*. Drawing on research findings concerning family influences on educational outcomes, in general, and reading proficiency, in particular, we investigated the influence of family structure and process variables on children's reading proficiency, vocabulary, reading motivation, and reading behavior (McElvany, Becker, & Lüdtke, 2009). A model was proposed in which the predictive effects of family structure variables on reading proficiency are mediated by reading-related family process variables and by individual characteristics. The hypothesized effects were tested empirically using longitudinal data obtained from 772 elementary students in grade 3 to grade 6. The findings confirmed the multifactorial structure of reading socialization in the family as well as a complex pattern of relationships between family structure and process variables, individual reading-related characteristics, and reading proficiency. Furthermore, considering the family as the primary agent of reading socialization, we investigated processes of intergenerational transmission in reading habits, behavior, and attitudes (McElvany & Becker, 2009). These analyses focused on families with children at the end of grade 6, who had already acquired basic reading skills. Based on theorizing about reading socialization and on attempts to explain gender-specific differences, we proposed a general structural model in which parental attitudes and behavior predict children's attitudes and behavior. Additionally, we probed for differential effects of home characteristics depending on the children's gender.

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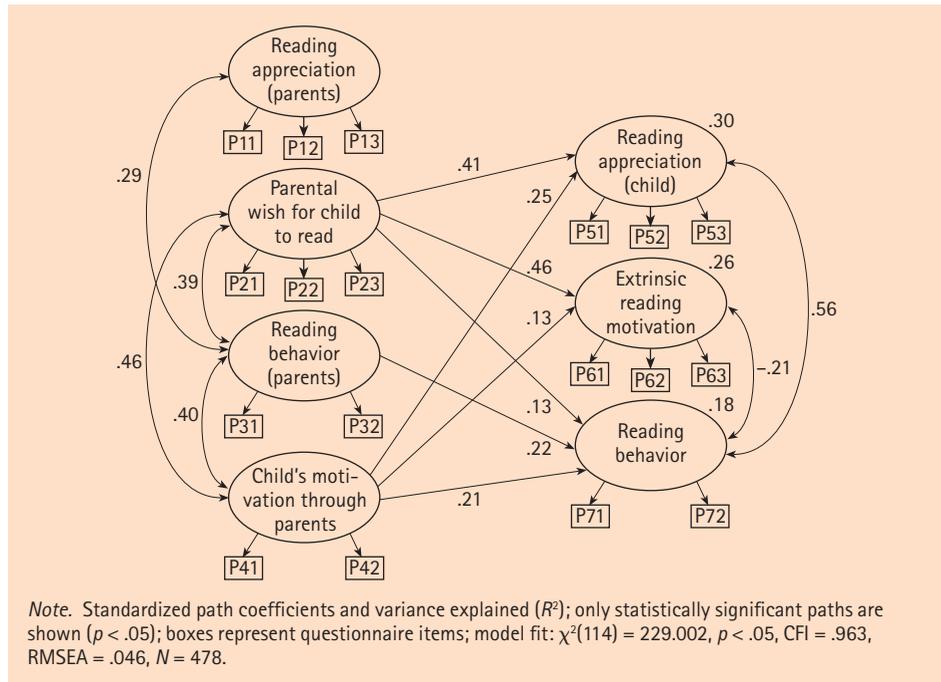


Figure 14. Intergenerational transmission of reading as a cultural tool: Structural equation model.

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The results depicted in Figure 14 support the hypothesis that reading-related attitudes and behavior are transmitted within the family. Further analyses revealed differential effects of family characteristics for boys and girls. For example, the perceived parental wish for children to read a lot had a strong effect on boys' extrinsic reading motivation, but for girls it also had an additional effect on reading behavior.

We further investigated the longitudinal effects of immigrant background on reading literacy, specifically in cases of mismatch between the school and home language. Mastery of the language of instruction, especially its written form, is a precondition for successful participation in class and the acquisition of academic knowledge and skills. Reading literacy is thus thought to play an important role in explaining group differences in the educational participation of students with and without immigrant backgrounds. In order to identify points of intervention for the reduction of differences in educational outcomes, we therefore need to be able to pinpoint and explain similarities and differ-

ences in the reading acquisition process in multilingual and monolingual children. In the context of the *Berlin Longitudinal Reading Study*, we addressed the following three research questions: (1) Is mismatch between school and home language a significant predictor of reading literacy in grade 3 and of the increase in reading skills from grade 3 to grade 6? (2) Do achievement gaps disappear when socioeconomic status and/or cultural capital are taken into account? (3) Are there group-specific differences in the power of socioeconomic status and/or cultural capital to predict reading acquisition? Our main results are summarized in Box 1.

Evaluating Psychological and Sociological Constructs as Predictors of Reading Literacy
Theoretical models and research on the psychology of reading have identified numerous individual factors as influencing the complex processes of reading and comprehension, including cognitive as well as motivational, emotional, and behavioral factors. Social process and status variables have also been discussed as relevant from several perspectives

Main Findings on the Effects of Immigrant Background on Reading Literacy

- Mismatch between the home language and the language of instruction has a negative effect on the level of text comprehension and vocabulary in grade 3 and on vocabulary acquisition from grade 3 to grade 6.
- When socioeconomic status and cultural capital were successively entered into the autoregressive cross-lag panel-model, immigrant background remained as a significant predictor.
- Multiple group analyses revealed substantially reduced predictive power of socioeconomic status and cultural capital for text comprehension in the group of children with an immigrant background.

Box 1.

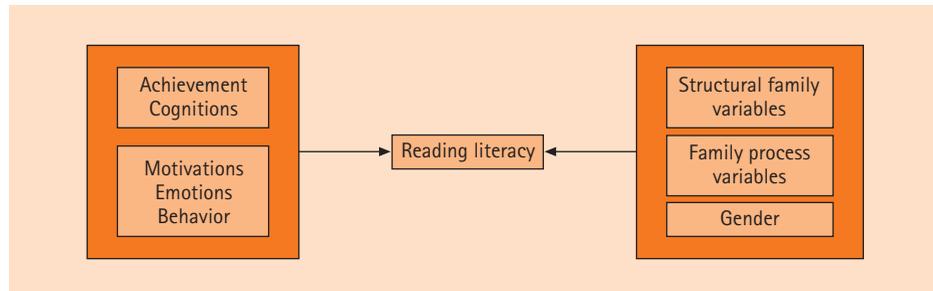


Figure 15. Psychological and sociological constructs predicting reading literacy.

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(see above). In recent analyses (McElvany & Becker, 2010), we have examined the relevance of a broad set of factors for reading literacy and determined the proportions of unique and shared variance explained by each (see Figure 15). First, cross-sectional analyses investigated the relations of individual and social factors with reading literacy among grade 6 students—an age that is crucial for the development of reading literacy. Second, analyses examined which proportions of the variance were specific and which were shared when individual and social structure and process factors were considered simultaneously. The results point to a clear and consistent predominance of cognitive factors over other areas of influence and highlight the importance of intellectual abilities and processes for reading literacy. This finding can usefully inform not only future research, but also practice, in terms of how the limited resources available to schools can best be applied to foster various aspects in the domain of reading.

Promoting Reading Literacy: Analyzing the Effectiveness of Family Literacy Programs and Assessing Teacher Competence

Reading Promotion: Family Interventions
In the *Berlin Parent–Child Reading Program*, a quasi-experimental intervention study integrated in the *Berlin Longitudinal Reading Study*, we examined the effectiveness of a systematic family-based intervention to support reading literacy and strategy use (McElvany & Artelt, 2009). Subsequently, we have investigated the potentials and challenges of family literacy interventions, and specifically the question of implementation quality, by evaluating our study in Germany as well as a study from the Netherlands targeting kindergarten and school-age children. The resulting publication identified, analyzed, and discussed aspects of implementation quality that may enhance or diminish the effectiveness of family literacy interventions (McElvany & Van Steensel, 2009). Three types of implementation variables were identified: (1) intensity and quality of parent–child

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Table 4
Differences and Similarities Between Family Literacy Policy and Programs in the Netherlands and in Germany

Aspect	Differences	
	The Netherlands	Germany
Nationwide family literacy programs	Yes	No
Development	Initial focus of early childhood education on home-based approaches; has now moved toward center-based programs	Started with some center-based approaches; now an increasing interest in home-based programs
Role of home language in program concepts and materials	Greater	Lower
<i>Similarities</i>		
<ul style="list-style-type: none"> • Family-based activities in both countries profit from experiences in other countries: Many programs in Germany resemble programs in the Netherlands, and most programs in both countries are, to some extent, based on internationally developed and implemented programs. • More research is needed on program effects, implementation quality, and other potential mediators. • There is room for improvement in the overall methodological quality of research. • Lobbying work for family literacy programs is required in both countries: in the Netherlands, focusing on defending existing programs; in Germany, on establishing a stable and comprehensive structure of family literacy programs. 		

activities, (2) support and training provided for parents, and (3) participation. Potential points of intervention were proposed for improving implementation quality in all three areas.

Finally, we reviewed current family literacy policies, programs, and evaluation studies in the Netherlands and in Germany (McElvany, Van Steensel, Guill, Van Tuijl, & Herppich, in press). One of our core findings is that family literacy as a central, organized, and structured system of interventions is still in its infancy in Germany, whereas the Netherlands can look back on a more comprehensive history in this area. Our comparison of family literacy policy and programs in the Netherlands and in Germany revealed both similarities and major differences (see Table 4).

A meta-analysis on the effectiveness of family literacy programs was conducted in cooperation with colleagues from the universities of Amsterdam and Tilburg (McElvany, Herppich, Van Steensel, & Kurvers, 2010; Van Steensel,

McElvany, Kurvers, & Herppich, 2011). The meta-analysis analyzed the results of 30 recent effect studies (1990–2010), covering 47 samples, and distinguished between effects in two domains: comprehension-related skills and code-related skills. A small, but significant, mean effect size emerged. There was only a minor difference between comprehension- and code-related effect measures. Moderator analyses revealed no statistically significant effects of three types of moderators derived from the publications reviewed: program characteristics, sample characteristics, and study characteristics. The results highlight the need for further research into how programs are implemented by parents and children, how program activities are incorporated into existing family literacy practices, and how program contents are conveyed to parents. In an additional publication, these results were contextualized within the results of other meta-analyses (Van Steensel et al., 2011).

Reading Promotion: Teacher Competence

A second research approach to effective ways of promoting reading literacy focused on the teacher as the primary agent of reading instruction. Recognizing the importance of teacher competence (see Research Area IV), the *Conditions for the Development of Reading Literacy at School* (CODE R) project drew on the COACTIV framework to develop a questionnaire assessing teacher competence in the area of reading literacy. The questionnaire covers elementary and secondary school teachers' knowledge, motivation, beliefs, self-regulation, and diagnostic skills in this area. Initial results for professional knowledge suggest that our theory-based test reliably measures teachers' content and pedagogical content knowledge in the area of reading literacy (McElvany, 2010c). A statistically significant, but only moderate, correlation emerged between the two knowledge subtests, indicating that the two theoretically differentiated areas of knowledge can also be empirically distinguished. Differences in teachers' knowledge were not systematically linked to teaching experience. This result is in line with findings from Research Area IV in the domain of mathematics. Thus, practical experience in schools alone does not seem to suffice to consolidate or increase teachers' professional knowledge. Rather, systematic in-service teacher training seems necessary.

In view of previous empirical findings on the significance of metacognition for reading comprehension and learning, we placed a special focus on teachers' knowledge about metacognition, both in general and specifically for reading, and their judgments of the relevance of this knowledge. Our research objectives were (1) to identify the knowledge about metacognition that should be available to teachers, (2) to compare it with the knowledge they actually have and examine any misconceptions that might be barriers to effective instruction, and (3) to explore teachers' perceptions of the relevance of knowledge about metacognition for teaching. Five areas of relevant knowledge were identified and operationalized by 49 items in 28 multiple-choice tasks. Findings showed

that elementary school teachers ($N = 135$) did have some relevant knowledge about metacognition. However, misconceptions were found in all five areas. Moreover, in general, teachers do not seem to attribute as much relevance to knowledge about metacognition as to other areas of reading-related knowledge.

Developing and Assessing Proficiency Models of Text–Picture Integration (BiTe)

Overview

As most school textbooks contain texts with instructional pictures (e. g., graphs, photos), the ability to extract and integrate information from both sources is critical for learning. Analogous to skill development in other domains, the development of students' ability to integrate textual and graphical information is likely to be considerably influenced by the instruction their teachers provide. Accordingly, models describing the structure and development of this competence at the student level should be complemented by corresponding models of teacher competence, particularly diagnostic skills.

The classroom use of texts with instructional pictures entails several problems. First, students often have misconceptions about the interpretation of instructional pictures. Second, many teachers are unaware of these misconceptions. Third, text–picture integration is neither taught systematically in German teacher education programs nor recognized as an important instructional goal (McElvany, Becker, & Lüdtke, 2009). Against this background, the *Text–Picture Integration* (BiTe) project investigates students' ability to integrate text- and picture-based information and teachers' ability to promote successful text–picture integration (Schnotz et al., 2010). The project is a cooperative endeavor of the Institute and the University of Koblenz-Landau. It is part of the *Priority Program "Competence Models for Assessing Individual Learning Outcomes and Evaluating Educational Processes"* (SPP 1293), which is funded by the German Research Foundation (DFG). The project is currently in the second phase of funding (2009–2011; see Figure 16), and a third phase is planned.

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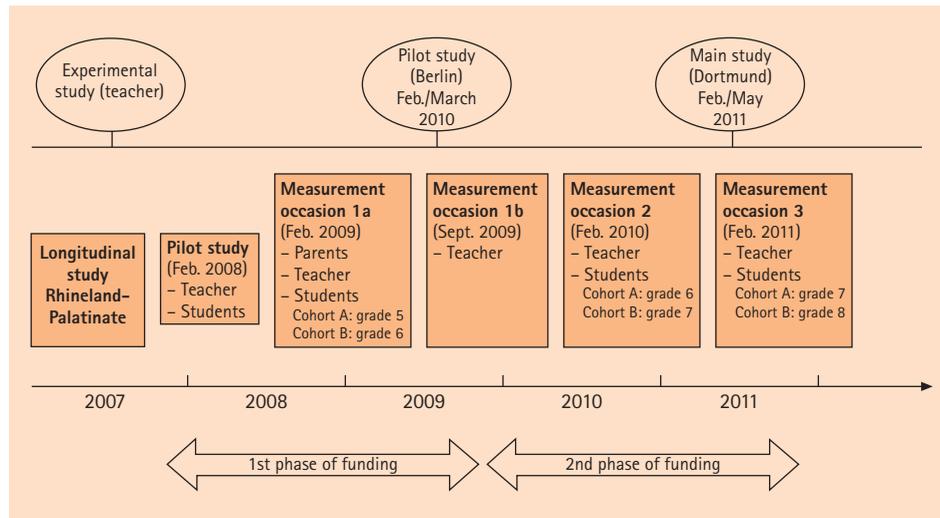


Figure 16. The Picture-Text Integration (BiTe) project: Overview of study design.

© BiTe

Diagnostic Skills

One focus of the second phase of the BiTe study has been on the assessment of teachers' diagnostic skills. Diagnostic skills are required for the adequate preparation, implementation, and evaluation of instruction and are thus a core component of teacher competence. Different aspects of diagnostic skills can be distinguished, and numerous studies have investigated the accuracy of teacher judgments in various domains. McElvany, Schroeder et al. (2009) were the first to study teachers' diagnostic skills in the context of texts with integrated pictures. The results are in line with earlier research indicating teacher judgments to be only moderately accurate. In fact, some aspects of teachers' diagnostic skills were found to be even less well developed than in previous studies. These findings, together with the rather weak correlations between teaching experience and the different aspects of diagnostic skills, highlight the need to enhance teacher education in the field of text-picture integration. Additionally, the research team recently investigated the reliability of widely used measures of teachers' diagnostic skills. Lintorf et al. (in press) raised substantial doubts about the reliability of some of the commonly used measures and discussed implications for future research.

Professional Development in the Field of Text-Picture Integration

The BiTe study has also addressed the connection between diagnostic skills and instructional behavior. According to the study's theoretical model, diagnostic skills influence instructional decision making, and this relationship is moderated by pedagogical content knowledge. Empirical evidence of these associations is lacking, however. To close this gap in the research, we first conducted a pilot study with a pre/posttest design and a control group to evaluate a video-based continuing professional development intervention in the field of text-picture integration. Comparison of the knowledge of the intervention and the control group at posttest clearly showed that the intervention was successful. Furthermore, regardless of prior knowledge or perceived quality of the intervention, all participants in the experimental group profited equally from the intervention in terms of increased knowledge. These results are highly relevant: From a theoretical point of view, they confirm that professional knowledge is learnable; from a practical point of view, the intervention appears to be a promising approach for in-service teacher education. Other results from the BiTe project are also promising with regard to professional development. Beyond knowledge and diag-

nostic skills, we expected teachers' personal characteristics to be further crucial determinants of their instructional behavior (see Schroeder et al., 2011). These characteristics include beliefs, motivation, self-efficacy, and self-regulation in the area of text–picture integration (see Research Area IV). Our data indicate positive levels of these characteristics (McElvany et al., 2010c). For instance, the participating teachers were clearly aware of the relevance of integrative reading for successful learning and had positive attitudes toward the topic with respect to their own instruction. In conclusion, the conditions for teaching students to integrate information from texts and pictures seem good—as long as teachers have the necessary didactic competence.

Language Assessment and Cognitive Predictors of Reading Ability

Reading is a complex cognitive skill that draws on many component processes and resources. The processes involved in comprehending a text include decoding single words, syntactic and coreferential processing, inferencing, and constructing a coherent representation of the overall meaning of the text. Because these processes are heterogeneous, the assessment of reading comprehension is a challenging task. Numerous tests and online methods for the assessment and investigation of reading processes have been developed. In educational research, reading comprehension is generally assessed by means of offline measures presented after the text has been read. Multiple-choice items are commonly used for this purpose, although other more informal measures are also used in instructional settings. It is well known that performance on multiple-choice comprehension items is influenced by processes associated with students' text processing as well as by processes necessary during the response decision phase. However, precisely which processes influence students' performance on different types of items remains a matter of debate in educational psychology and assessment. The *Cognitive Language Assessment* (CLAss) project was initiated in summer 2008 to clarify the relationship between reading

proficiency tests and the cognitive processes specific to reading.

What Readers Have and Do

Interestingly, very little is known about what students actually *do* while reading the texts in reading comprehension tests—which cognitive processes they engage in and which of these processes have consequences for their comprehension performance. In order to successfully comprehend a text, readers have to construct a stable text-based representation and generate a coherent situation model. To this end, they have to engage in the complex, dynamic, and continuous allocation of attention to several component processes of reading as they read, and they need to execute these processes in an efficient and coordinated fashion. However, readers' resource allocation is also constrained by their verbal resources. As a result, students' resource allocation strategies and verbal resources interact and are likely to have unique as well as shared effects on comprehension. To further complicate the picture, the interacting effects of resource allocation and verbal ability on comprehension may depend on characteristics of the comprehension questions and on the way the test is administered.

To close this knowledge gap, we investigated the reading behavior of 15-year-old students who were reading texts to answer multiple-choice items (Schroeder, in press-b). Students' word-by-word reading times were collected as a fine-grained online measure of their reading behavior. We asked 125 students to read the texts of the reading-comprehension test on computers using the "moving-window" method. In this paradigm, the letters of a text are replaced by the symbol "~". When the reader presses the space bar, the first word of the text is revealed. At the next press of the space bar, the first word is concealed again and the second word revealed, and so forth (see Figure 17). After reading the text in this manner, the students answered the corresponding questions. We were thus able to measure how much time each reader spent on each word of a text and, at the same time, to assess reading comprehension.

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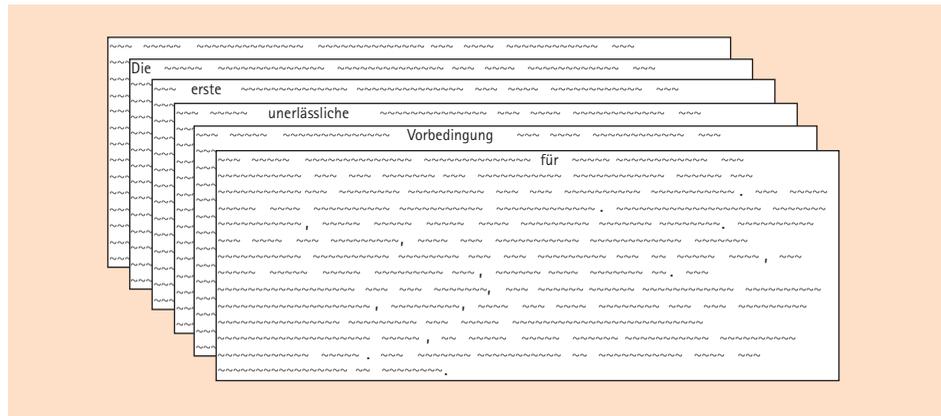


Figure 17. The first words of a text as read in the moving-window paradigm.

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The allocation of resources to several cognitive processes at the word, sentence, and text level was measured by relating reading times to linguistic variables of the text that are sensitive to these processes. We further explored whether reading-time components were influenced by students' verbal ability and investigated their unique and shared effects on comprehension. The availability of the texts during question answering was manipulated experimentally, and differential effects for different text and item types were investigated.

Results showed that there were substantial interindividual differences in resource allocation to the different component processes. Further analyses revealed that this variance was systematically related to students' verbal ability and to their reading comprehension: There were both unique and shared effects of reading-time components and verbal ability on test performance. In sum, approximately 50% of the variance in comprehension was explained by the combined effects of the two sets of variables. Approximately one third of this variance was associated with interindividual differences in text processing—either because ability effects were mediated by reading behavior or because strategic differences in resource allocation contributed independently to comprehension. Students with higher verbal ability and better comprehension encoded infrequent concepts more carefully, spent more time on conceptual

integration, and updated their situation model more carefully. However, comprehension did not depend on resource allocation to a single linguistic feature, but on the orchestration of several interrelated processes. Overall, the results of the present study are in opposition to those of studies that found no relationships between text processing behavior and reading. Instead, the present study suggests that there are moderate, but stable, relations between verbal abilities and text processing behavior, indicating that readers' processing strategies are sensitive to the available resources.

Analyzing High- and Low-Skilled Readers' Word Decoding Processes

A second line of studies in the CLAs project focused on low-skilled readers' word decoding processes. There is ample evidence that low-skilled readers have problems with word identification and lexical access. Readers who differ in reading comprehension ability generally also differ in the accuracy and speed with which they decode letter strings and access the meaning of words. Although there is wide acknowledgment that low-skilled readers have difficulties with word decoding, the precise locus of these deficits remains unclear. Word identification is a complex process involving visual perception, sublexical phonological processing, and retrieval of semantic information from the mental lexicon. Because impairments in each of these subprocesses necessitate different remedial activities, it is

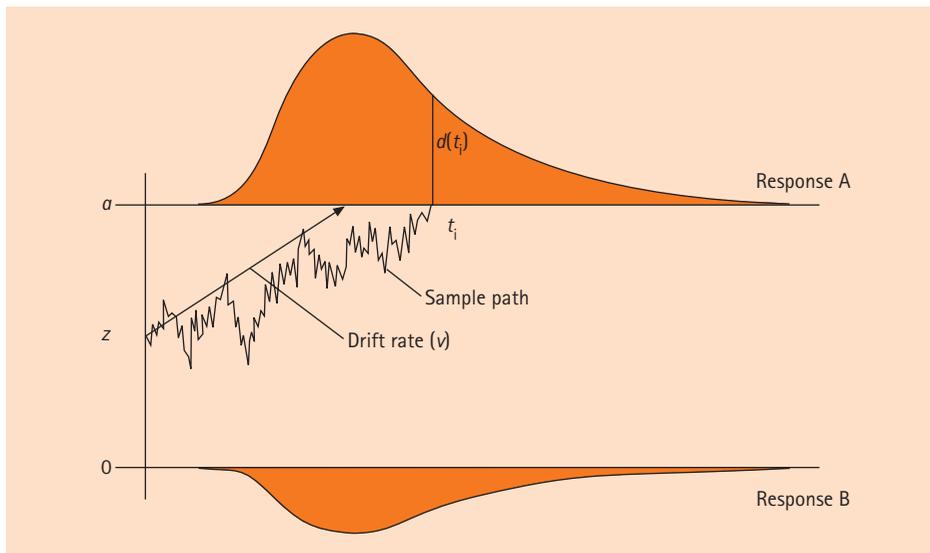


Figure 18. Graphical illustration of the diffusion model.

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important to understand where exactly in the word recognition architecture the deficits of less-skilled readers are located.

In one study (Schroeder, in press-a), we concentrated on low-skilled readers' nonword deficit, that is, on the fact that low-skilled readers typically perform much worse on nonwords or uncommon words than on common words. A prominent explanation of this deficit in opaque orthographies, such as English, is that low-skilled readers have a fundamental phonological deficit that impedes the acquisition of reliable sublexical decoding procedures. In a lexical decision experiment, we tested another plausible account of the nonword deficit that is particularly attractive for German: that low-skilled readers rely less on syllabic and multiletter information. In German, syllable structure is complicated because German syllables are usually closed and often contain many consonant clusters. As a consequence, assembly of the phonological code is more complicated in German and involves the use of complex multiletter rules. To test the hypothesis that low-skilled readers in German use multiletter information inefficiently, we manipulated the way words were presented to the students. In one condition, letter strings were presented in standard format. In a second condition, letter

strings were presented in MiXeD cAsE, which is known disrupt the use of multigrapheme information. When the stimuli were presented in standard case, low-skilled readers showed a substantial nonword reading deficit, that is, they had particular problems decoding nonwords. When stimuli were presented in MiXeD cAsE, in contrast, high-skilled readers showed the same nonword reading deficit as low-skilled readers. In other words, both groups were equally impaired in nonword processing. This finding indicates that, in normal reading, high-skilled readers make use of multiletter information to speed up phonological decoding, but that they were unable to do so in the mixed-case condition. In contrast, low-skilled readers tend to decode graphemes in isolation and rely less on suprasegmental information, even in normal reading.

In a second study (Schroeder, in press-c), high- and low-skilled readers' word decoding processes in two lexical decision experiments were analyzed using the diffusion model. Diffusion models have recently been used to dissociate the cognitive processes involved in the lexical decision task. They allow task performance to be decomposed into several unobserved psychological processes, each represented by a parameter of the model (see Figure 18). In particular, response perfor-

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mance is decomposed into a component that represents the speed of information uptake from the stimulus (called drift rate), a response caution parameter, a component indexing response bias, and a parameter that represents the time spent on processes unrelated to the decision process, such as stimulus encoding and motor response execution. Results showed that low-skilled readers' deficits were consistently attributable to lowered drift rate parameters; the nondecision component and response caution varied little between low- and high-skilled readers. This pattern of results was observable under a wide range of conditions, including poly- and monosyllabic stimuli as well as words presented in standard and mixed-case format. This pattern of findings suggests that the processing deficits of low-skilled readers result from impaired lexical processes and not from deficits in low-level perceptual processing. Furthermore, results indicate that low-skilled readers' deficits are partly attributable to the

inefficient use of the fast word-level route in high-frequency word recognition. However, the main processing deficit of low-skilled readers originates from the letter level and relates to phonological processing.

Outlook

Work on the projects that emerged from Research Area III will continue. Nele McElvany is now at the Technical University of Dortmund, from where the *Berlin Longitudinal Reading Study* and the BiTe project are now being coordinated. The *Berlin Longitudinal Reading Study* is being conducted in ongoing cooperation with Michael Becker, who is now at the University of Potsdam. Sascha Schroeder is now at the University of Kassel, where work on the CLAss project is being continued. For example, a study is currently being prepared on shallow processing and how students can be taught to invest their cognitive resources more efficiently during reading.

Research Area IV: Professional Competence of Teachers and Cognitive Activation in the Classroom

Research Area IV focuses on the teacher as a critical lever for improving the functioning and outcomes of the educational system. Building on our earlier research on powerful learning environments, our research program has progressed from describing features of high-quality classroom instruction to identifying the knowledge and skills that teachers need to create such successful learning environments. Drawing on a theoretical model of teacher competence, we have devised tools and procedures to tap interindividual differences in the knowledge, beliefs, and psychological functioning of teachers and found that these aspects of teacher competence are systematically linked to differences in instructional quality. Our most recent focus has been on how teachers acquire this professional competence. We have examined the learning experiences provided in the teacher education system and how teachers' professional competence changes over their education and career. A key source of data in this context is the COACTIV-R study, a longitudinal study investigating teacher candidates' professional development during the practical phase of teacher education.

Work in Research Area IV integrates research on instructional quality and research on teachers' professional competence. This work was inspired by the analyses of instructional quality conducted in the context of the *Learning Processes, Educational Careers, and Psychosocial Development in Adolescence and Young Adulthood* (BIJU) study, which led to the first systematizations of the field, especially with respect to domain-independent dimensions of instructional quality. The paradigm was further developed, particularly in terms of methods, in the German national extensions to the *Third International Mathematics Study* (TIMSS) and analyses of the TIMSS Video data. These empirical findings provided the basis for a model of "good instruction": a cognitively activating learning environment that offers students opportunities for insightful learning through the selection and implementation of cognitively challenging tasks and that, at the same time, provides adaptive support for individual students' learning processes in an effectively structured context.

Our research thus focuses on three general features of instruction that are crucial for insightful learning processes in secondary school mathematics: cognitively activating elements, classroom management, and individual learning support. It is important to note that the uptake of learning opportunities depends both on the students themselves (in terms of their individual strengths and

weaknesses) and on situational affordances and constraints (Kunter & Voss, 2011). Successful instruction thus hinges on the degree to which instructional strategies are suited to the needs of both the situation and the students. Instructors need to provide challenging tasks, monitor student learning, and adapt their teaching as appropriate to support active and independent knowledge construction across the whole class.

Yet, it is no easy matter to create challenging and suitable learning conditions for groups of students whose motivation and prior knowledge may differ greatly. Such deliberate, but, at the same time, flexible and adaptive classroom practice depends on a solid knowledge base, supported by adaptive beliefs and psychological functioning. Until recently, teachers' professional competence had rarely been measured by quantitative means. To close this knowledge gap, we have developed a model of professional teacher competence and instruments for its empirical assessment (Kunter & Klusmann, 2010a; Kunter, Klusmann, & Baumert, 2009). The model combines aspects of teacher knowledge, beliefs, motivations, and psychological functioning. It is based on the idea that teachers acquire their professional competence in both their initial training and classroom practice. Hence, we see teachers not only as providers of education but also as professional learners. Like their students, teachers acquire their skills through the active construction

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of knowledge and uptake of the learning opportunities available to them. In the first step of our research program, we developed and validated empirically sound measures to tap the theoretically postulated aspects of teacher competence. Second, as a crucial part of the validation process, we investigated the link between teachers' competence and the quality of their instruction, examining the relative importance of the different dimensions of domain-specific knowledge. Building on these results in a third step, we extended our theoretical approach from a focus on teachers' subject-related knowledge and skills to a broader model of teacher competence that encompasses noncognitive aspects, such as motivation and self-regulation as well as subject-unspecific aspects of professional knowledge. Fourth, we investigated the malleability of teacher competence and how it can be improved in formal teacher education.

Data Base: The COACTIV Research Program

Since its inception in 2002, the COACTIV research program has been systematically developed at the Institute (see Table 5). The research program is dedicated to the study of the structure, development, and consequences of teachers' professional competence. The first main study in the program was COACTIV, a research project embedded in the longitudinal extension of PISA 2003. Within this first main study, we first developed a theoretical model of teachers' professional competence as well as instruments for its assessment. The opportunity to link the COACTIV teacher data to longitudinal data obtained from their students in the PISA 2003/2004 assessment allowed us to test the practical relevance of this professional competence for the quality of teachers' instruction and for student learning outcomes.

The second main study in the COACTIV research program was COACTIV-Referendariat (COACTIV-R), which ran from 2007 to 2009. COACTIV-R investigated teacher candidates' acquisition of professional knowledge during the obligatory 2-year phase of teaching practice (i. e., the *Referendariat*) that is required to become a fully licensed teacher in Germany. COACTIV-R investigated the

development of professional competence during this second phase of teacher education using a longitudinal study design with two points of measurement and two cohorts of teacher candidates in consecutive years. A focus of the study was on the development and testing of new instruments to assess the generic pedagogical/psychological knowledge of beginning teachers. At the same time, the existing instruments were revised and extended.

The most recent element of the COACTIV program is the project entitled *Broad Educational Knowledge and the Acquisition of Professional Knowledge in Teacher Candidates* (BilWiss), which is being conducted in cooperation between the Institute, the University of Frankfurt a. M., the University of Duisburg-Essen, and the University of Munster. This third main study, which will run from 2009 to 2012, focuses on the university-based component of teacher training and examines the teacher candidates' broad educational knowledge. These three main studies were complemented by several smaller ones. After the initial COACTIV study, we tested the construct validity of our newly developed assessments of mathematics teachers' content knowledge and pedagogical content knowledge in selected contrast populations (COACTIV Construct Validation Study). This study was initiated at the Institute and conducted at the University of Kassel as part of a project funded by the German Research Foundation (DFG). To learn more about the development of professional competence during teacher education, we carried out a study with university students in 2008 (COACTIV-Students). The cross-cultural validity of the new assessments was tested in a comparative study with practicing teachers in Taiwan (COACTIV-International). This study was conducted in spring 2009 as a collaborative project of the Institute and the National Academy of Educational Research (NAER) in Taipei. In a fourth validation study, *Stress and Burnout in the Teaching Profession: An In-Depth Analysis of the Role of Personal and Institutional Resources* (BELE), we tested the capability of the COACTIV instruments to assess motivation and self-regulatory skills in a sample of clinically stressed teachers.

Table 5
Overview of the COACTIV Research Program

<i>Main studies</i>	<i>Design</i>	<i>Focus</i>
COACTIV	<ul style="list-style-type: none"> • 194 mathematics teachers • Embedded in PISA 2003/2004 • Repeated measurement (1 year) 	<ul style="list-style-type: none"> • Development of measures • Links between teacher competence/ instruction/students
COACTIV-R	<ul style="list-style-type: none"> • 856 mathematics teacher candidates • Repeated measurement (1 year) 	<ul style="list-style-type: none"> • Validation of competence model • Description of development during teacher training • Identification of individual and institutional conditions for development
BilWiss	<ul style="list-style-type: none"> • Approx. 3,500 graduates of university teacher education programs • Test of educational knowledge • Subsample: Repeated measurement (1 year) 	<ul style="list-style-type: none"> • Analysis of the structure of educational knowledge • Comparison of students in different teacher education programs
Smaller studies	<ul style="list-style-type: none"> • COACTIV Construct Validation Study • COACTIV-Students • COACTIV-International (Taiwan) • BELE (Stress and Burnout in the Teaching Profession) 	

The results of all of these studies have fed into the development of a theoretical framework that systematizes the structure, antecedents, and effects of teachers' professional competence. To make this framework and the wealth of empirical results available to a broader audience and to give a comprehensive overview of our research, we have recently published an edited volume reporting the main findings of the program (Kunter, Baumert et al., 2011). A version adapted to an English-speaking audience is in preparation and is expected to be published in late 2011.

A Model of Teachers' Professional Competence

The theoretical basis for our work on teachers' professional competence is a general model of professional competence that draws on Weinert's work on the concept of competence, combining it with the taxonomic approaches of Shulman and Bromme and with approaches from motivational psychology (see Figure 19). The model distinguishes between teachers' professional knowledge, beliefs, motivational characteristics, and self-regulation and postulates that all of these aspects of teacher competence are needed to meet the demands of the profession. We place a particular focus

on the classroom situation and on identifying those teacher characteristics that contribute to effective instructional practice, with positive effects on student learning outcomes. Taking a multicriterial approach, we also consider other criteria of professional success, which are labeled "Teacher outcomes" in Figure 21, and encompass aspects of continuing professional development and occupational well-being (Klusmann, Kunter, & Trautwein, 2009; Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011).

Central Aspects of Professional Competence

At the core of our empirical work is an understanding of competence as the knowledge, skills, attitudes, and motivational variables needed to master specific situations. The term "professional competence" applies this concept to the world of work and particularly to complex and demanding professions such as teaching, in which the mastery of situations depends on the interplay of knowledge, skills, attitudes, and motivation. There is ample evidence that teachers' professional knowledge, beliefs, work-related motivation, and ability for professional self-regulation are important determinants of their teaching success. In our research, we have specified these aspects of

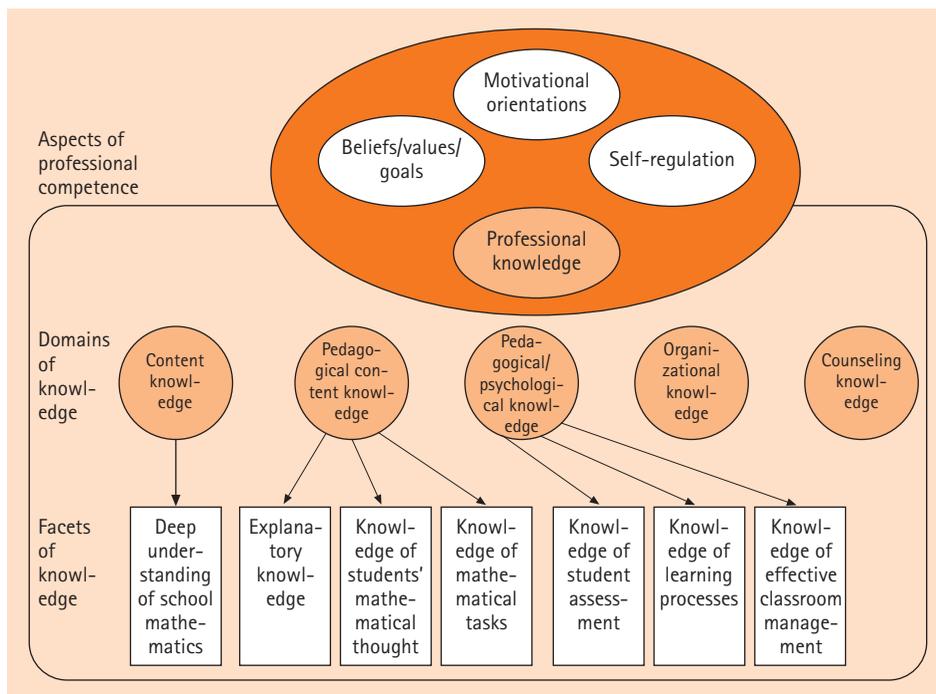


Figure 19. The COACTIV model of teachers' professional competence as specified for mathematics teachers.

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teacher competence to apply to mathematics teachers in secondary education.

Professional knowledge is a core component of teachers' professional competence. One of our major research objectives in recent years has been to develop a comprehensive taxonomy of this knowledge. Drawing on Shulman and Bromme, we have distinguished several domains of teachers' professional knowledge (see Figure 19). *Content knowledge* is conceptualized as a deep mathematical understanding of the content to be taught. This professional knowledge includes a masterly command of the content of the school mathematics curriculum, but neither this school-level knowledge nor everyday mathematical knowledge equip teachers for the challenges of preparing and delivering instruction. Content knowledge is therefore distinguished from *pedagogical content knowledge*, which Shulman defines as the knowledge necessary to make mathematical content accessible to students. Three facets of pedagogical content knowledge are considered crucial: knowledge of strategies for representing and explaining learning content in a specific subject, knowl-

edge of the didactic potential of tasks and sequences of tasks for learning processes, and knowledge of subject-specific student cognitions. As a further dimension of knowledge that is directly relevant to classroom practice, *pedagogical/psychological knowledge* comprises the generic cross-curricular knowledge needed to create and optimize teaching and learning situations, including a basic understanding of developmental and educational psychology, and knowledge of lesson planning, instructional methods, and classroom management strategies. Teachers' professional knowledge also includes the broader educational knowledge needed especially for their work outside the classroom, such as knowledge about the organization of the school and the school system and a capacity for adaptive and effective communication, particularly with laypeople. Drawing on data from the first COACTIV study, we found that content knowledge and pedagogical content knowledge both made unique contributions to explaining differences in the quality of teachers' instruction and their students' outcomes. The embedding of COACTIV

in the longitudinal PISA 2003/2004 assessment allowed us to link student and teacher data, thus creating a quasi-experimental situation in which differences in student achievement were directly attributable to differences in teacher knowledge. Multilevel structural equation modeling revealed a substantial positive effect of pedagogical content knowledge on students' learning gains that was mediated by the provision of cognitively activating and adaptive instruction. Pure content knowledge, although systematically linked to pedagogical content knowledge, was not directly linked to higher instructional quality (Baumert, Kunter et al., 2010).

Teachers' beliefs are implicit or explicit conceptions that influence their perception of the environment and their behavior. We distinguish professional values and ethics; epistemological beliefs about the structure, development, and validation of knowledge; and beliefs about learning content, lesson planning, and instructional practice. Specifically for mathematics instruction, two opposing belief sets can be described both theoretically and empirically. On the one hand, teachers may take a "transmission view" that draws on traditional learning theories and tends to see students as passive receivers of information. On the other hand, teachers may take a "constructivist view" that endorses the principles of active and constructive learning. Drawing on data from the first COACTIV study, we found that the latter is more conducive to high-quality instruction than the former (Voss, Kleickmann, Kunter, & Hachfeld, 2011).

Motivational Orientations and Self-Regulation

The teaching profession is characterized by a relative lack of external constraints on—or control of—teachers' behavior. The typical career path offers few direct incentives or rewards to enhance occupational commitment. At the same time, the profession makes high demands on teachers' attention, energy, and frustration tolerance. Adaptive motivational orientations and self-regulation skills are thus vital for teachers to succeed in their jobs in the long term. Aspects of intrinsic motivation, such as enthusiasm, interests, control beliefs,

and self-efficacy beliefs, seem important for the development and maintenance of occupational commitment (Kunter, 2011a). Indeed, our research showed that teachers' enthusiasm for teaching was systematically linked to their instructional quality and their students' outcomes (Kunter, 2011b).

At the same time, self-regulation skills (i. e., the ability to distance oneself from one's work and to cope adaptively with stress) are needed to maintain occupational commitment in the long term and to preclude unfavorable motivational and emotional outcomes. Our data confirmed that better self-regulation skills were systematically linked to higher instructional quality, better student motivation, and lower rates of teacher exhaustion (Klusmann, Kunter, & Trautwein, 2009).

Domain-General Knowledge

Our research on teachers' professional competence was motivated by the observation that German mathematics teachers, in particular, seemed to lack knowledge of how to make mathematical content comprehensible to their students. In the first phase of our research program, we focused on teachers' domain-specific knowledge, content knowledge, and pedagogical content knowledge. However, it is clear that there is much more that teachers need to know in order to create powerful learning situations. In our ongoing studies, we have therefore extended the focus of our research from teachers' subject-related knowledge and skills to the domain-general knowledge needed in the teaching profession. In the COACTIV-R and BilWiss studies, we have developed measures to test teachers' domain-general knowledge and are examining the practical relevance of this knowledge for classroom practice and learning outcomes. One area of domain-general knowledge that is particularly relevant for the classroom situation is teachers' general pedagogical/psychological knowledge (PPK). This can be defined as the knowledge needed to create and optimize teaching-learning situations across subjects, including declarative and procedural knowledge of classroom management, teaching methods, classroom assessment, and student heterogeneity. Although

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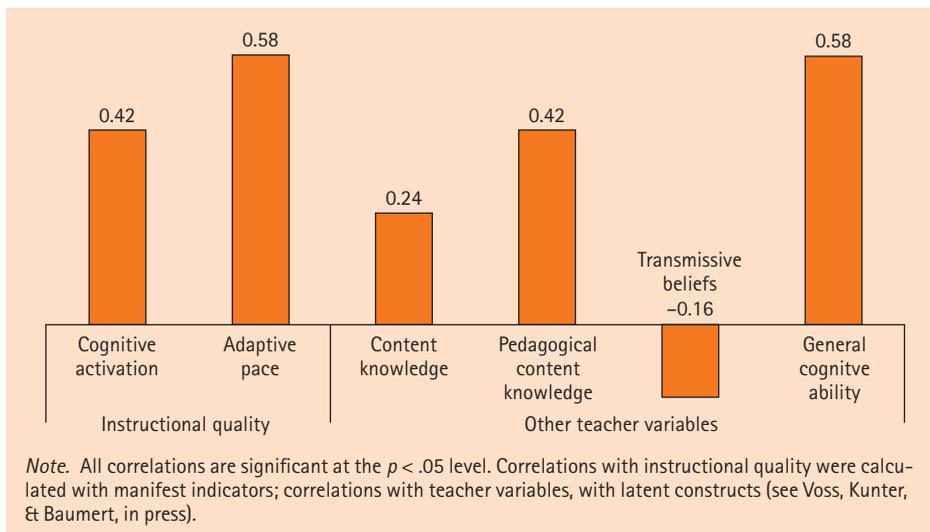
Table 6
Examples of Items Developed to Tap General Pedagogical/Psychological Knowledge

<p><i>Knowledge of classroom management</i> Videotaped vignette (situation): The class is looking at a topic in depth. There is a class discussion of an interesting task; the teacher keeps asking questions. Most of the students are concentrating. Mario is sitting in the second row. He calls out something that has nothing to do with the topic under discussion. His response prompts some students to giggle and mess about. The teacher doesn't react and tries to keep the class discussion going. Mario sits back, crosses his arms, and does not participate any further. At some point, he begins to rummage around in his bag and takes out a tennis ball, which he then holds in his hands. The class takes no notice of him and carries on working. Mario begins to throw the ball gently into the air and catch it.</p> <p>Short-answer questions: (A) How do students interfere with instruction? Please describe all disruptive behaviors you have seen in as concrete terms as possible. (B) A boy in the class has been playing with a ball at his desk. Imagine you are the teacher and are concerned that he will at some point start throwing the ball around. What could you do to prevent him from doing so without interrupting the class discussion? Please list all concrete steps you could take.</p>
<p><i>Knowledge of teaching methods</i> It is often observed that some students do not give their best effort in group work contexts. Please give ... (A) possible reasons for this phenomenon (2–3 sentences). (B) possible ways of structuring group work to alleviate the problem (2–3 sentences).</p>
<p><i>Knowledge of classroom assessment</i> You have set your class a test. You want to grade Peter according to ... (A) a social frame of reference. With what do you have to compare Peter's performance in the test? (B) an individual frame of reference. With what do you have to compare Peter's performance in the test? (C) an objective (criterion-based) frame of reference. With what do you have to compare Peter's performance in the test?</p>
<p><i>Knowledge of student characteristics</i> Imagine that you have told your class you will be setting them a test next week. A colleague tells you that he thinks Maria suffers from high test anxiety. Which of Maria's characteristics could be seen as indicators for high anxiety in achievement situations? Report all the characteristics that come to mind.</p>

PPK is thought to be an important aspect of teacher quality, it has to date seen little empirical investigation—largely because no direct and valid measure of PPK has previously been available.

In order to close this gap, we have developed a 39-item measure using multiple-choice items, short-answer items, and video-based items to assess PPK. One part of the test involves short video vignettes presenting critical classroom situations in terms of preventive/proactive classroom management. These videos, which show authentic scenes re-enacted by grade 5 to grade 7 classes, are presented to participants. After each sequence, written short-answer questions are administered, the first question requiring the identification of critical elements in the scene and the second question assessing strategies for preventing or

dealing with the problem. Other items tapping teachers' knowledge of teaching methods, assessment, and student heterogeneity are presented in traditional paper-and-pencil format. Table 6 gives examples of our test items. The PPK test has been developed and optimized in several pilot studies. Experts have rated the items to be relevant for teaching, domain general, and authentic. The COACTIV-R study provided further evidence for the measure's validity. Data obtained from 746 German teacher candidates supported the hypothesized nomological network of PPK; the measure was sensitive to differences between groups; and variations in PPK did not overlap to any great extent with variations in discriminant constructs, such as domain-specific knowledge, beliefs, and general reasoning abilities. Furthermore, PPK was positively



Key Reference

Voss, T., Kunter, M., & Baumert, J. (in press). Assessing teacher candidates' general pedagogical and psychological knowledge: Test construction and validation. *Journal of Educational Psychology*.

Figure 20. Criterion validity of the PPK test: Correlations with discriminant constructs and teaching quality.

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associated with indicators of instructional quality as seen from the students' perspective (see Figure 20).

PPK (along with content knowledge and pedagogical content knowledge) represents knowledge that is directly relevant for teachers' classroom practice. However, teachers' professional responsibilities go beyond classroom teaching. They are also expected to advise students and parents, to guide and support students with nonacademic problems, and to engage in school development processes. Specific professional knowledge is again needed to succeed in all these tasks. In our latest study within the COACTIV research program, we focus on this broad educational knowledge. The BilWiss study examines the relevance of the broad educational knowledge (spanning educational science, educational psychology, educational law, and the sociology of education) that teacher candidates acquire during university training for their later professional practice. The objective is to empirically test the hypothesis that this broad educational knowledge provides a necessary conceptual framework that enables teachers to properly interpret and reflect on school-related events and that thus informs their professional development. The study was initiated in October 2009 as

a joint project with researchers from the universities of Munster und Duisburg-Essen. In a first step, we analyzed teacher training curricula and conducted a Delphi study with 49 experts in teacher education. On this basis, we developed a taxonomy specifying the components of broad educational knowledge needed to master the task of teaching. These components were then operationalized in a knowledge test of more than 300 items that are currently being tested and fine-tuned in pilot studies. The test will be implemented in a large sample of teacher candidates at the end of their university-based training to provide first descriptive data. The relevance of the components assessed for actual classroom practice will then be investigated in a longitudinal study with beginning teachers during their obligatory teaching practice and in their entry year.

Cooperation Partners

Detlev Leutner,
University of
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Ewald Terhart,
University of Munster

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Kunter, M., Kleickmann, T., Klusmann, U., & Richter, D. (2011). Die Entwicklung professioneller Kompetenz von Lehrkräften. In M. Kunter, J. Baumert, W. Blum, U. Klusmann, S. Krauss, & M. Neubrand (Eds.), *Forschung zur professionellen Kompetenz von Lehrkräften: Ergebnisse des Projekts COACTIV* (pp. 55–68). Münster: Waxmann.

The Development of Professional Competence

At the core of our model of professional competence is the idea that aspects of teachers' professional competence are generally learnable and teachable. Our results to date show that teachers differ considerably in all aspects of competence investigated as well as in the structure of their knowledge. In our recent studies, we have therefore focused on the processes that support the development of teachers' professional competence. We consider teachers—like their students—to be professional learners who develop their competence through the uptake of learning opportunities available to them and the active construction of knowledge. These learning opportunities may be formal learning arrangements, such as teacher education or professional development courses, or learning opportunities in the immediate school context (e.g., when particular problems in a class need to be addressed). The form and frequency with which these learning situations occur is often subject to contextual influences (e.g., the educational system; see Figure 21). However, the mere existence of learning opportunities is not the decisive factor in determining whether competence develops. Teachers' uptake of learning opportunities depends not

only on situational affordances and constraints but also on the characteristics of the teachers themselves. Personal characteristics that may influence teachers' learning behavior and career choices include their general cognitive abilities, prior knowledge, beliefs, and long- and short-term goals (Kunter, Kleickmann, Klusmann, & Richter, 2011). The determinants of teacher competence have rarely been examined directly in empirical research. Studies on the impact of teacher education programs on teachers' knowledge and beliefs have provided some indirect pointers. However, many of these studies used distal rather than proximal measures of teacher competence and were cross-sectional in design. Moreover, there has been no specific investigation of the interplay between various competence aspects (e.g., knowledge and motivation) or of the relations between personal characteristics (i.e., traits) and professional competence. Our new studies COACTIV-R and BilWiss were initiated to help close this gap in the research. In these studies, we explicitly target the role of different elements of teacher education programs in supporting the development of teacher candidates' professional competence. These studies combine longitudinal designs, systematic quasi-experimental variation of different

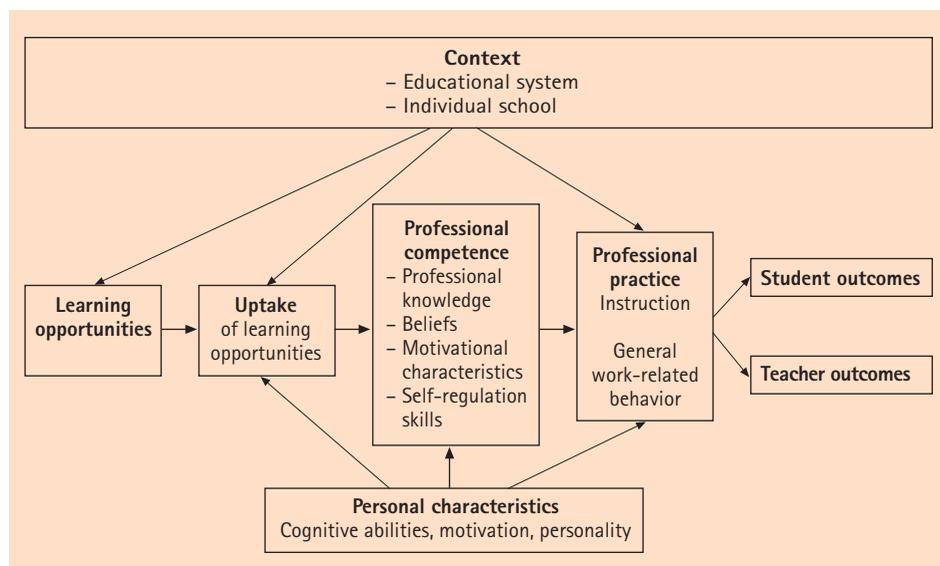


Figure 21. Determinants and effects of teachers' professional competence.

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learning opportunities, and psychometrically sound proximal measures of teacher competence, thus making it possible to draw conclusions on the efficacy of different elements of teacher education.

In Germany, teacher education is organized in three phases. During the first, university-based, phase, teacher candidates acquire theoretical knowledge. This phase has often been criticized for being too theoretical. As outlined above, the core research question of the new BiWiss project is to examine the practical relevance of the knowledge that teacher candidates acquire in university for their later classroom practice. In the second, teaching placement, phase (*Referendariat*), teacher candidates gain practical knowledge by observing lessons and teaching classes themselves. During this 2-year phase, they are both teachers and students, teaching their own classes, but being supervised by a mentor and attending preparatory seminars. After completion of the *Referendariat*, teachers are fully licensed and enter the workforce. The structured learning opportunities of the *Referendariat* offer great potential for development and are the subject of the COACTIV-R study (R meaning *Referendariat*). The third phase of teacher education comprises all learning opportunities available to teachers after their formal education is completed. As we explain below, it is during this phase that individual differences in prior knowledge and motivation probably have the greatest influence on the uptake of learning opportunities.

Competence Development in the Second Phase of Teacher Education: The COACTIV-R Study

COACTIV-R is a longitudinal study with two main measurement points and two cohorts: teacher candidates in the first and second year of the *Referendariat*. Data were collected in four federal states (Bavaria, Baden-Wuerttemberg, North Rhine-Westphalia, and Schleswig-Holstein), which were chosen because they differ systematically in the structure of the *Referendariat*. The first wave of data collection took place between fall 2007 and spring 2008; data were obtained from 856 teacher candidates training to teach mathematics at lower secondary level in all

school tracks. The second wave of data collection ran from fall 2008 to spring 2009, with data from a further 570 teacher candidates being obtained. A follow-up assessment was carried out in summer/fall 2010 to investigate the participants' professional development after completion of the *Referendariat*. First analyses of the data from the first measurement point of COACTIV-R confirm the importance of structured learning opportunities for the acquisition of professional knowledge. Consistent with the different curricula implemented for teacher candidates qualifying for different school types, we found that *Gymnasium* teacher candidates, who receive more instruction in their teaching subjects, outperformed other candidates in terms of content knowledge and pedagogical content knowledge. At the same time, teacher candidates qualifying for nonacademic tracks, who receive more instruction in pedagogy and psychology, outperformed the *Gymnasium* teachers in the PPK test (Kleickmann & Anders, 2011). Regarding the development of the different aspects of teacher competence during the *Referendariat*, first analyses show distinct trajectories. Whereas professional knowledge shows only small linear increases, motivational variables seem to follow a U-shaped pattern, with high starting values that drop off over time and then recover. Beliefs, on the other hand, seem to remain stable throughout the induction phase. Supplementary studies have examined specific aspects of teacher candidates' professional competence in more detail. A trajectory study tracked short-term change in beliefs, motivation, and emotions by assessing a subsample of teacher candidates from North Rhine-Westphalia at three additional points of measurement between those of the main assessment. In a diary study, a cross-state subsample of teacher candidates gave daily reports on their learning activities and psychological well-being over a 2-week period, allowing short-term fluctuation in emotional and motivational variables to be examined. In a mentoring study, another subsample of teacher candidates provided information on their in-school mentors and teaching practice. Finally, in an instructional quality study, we obtained

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student ratings of the instruction of a smaller subsample of teacher candidates at three points of measurement, allowing us to examine the relationship between the candidates' professional competence and performance in the classroom. First results from the COACTIV-R study have been reported in the dissertations of Tamar Voss, who investigated teachers' PPK (see above), and Dirk Richter, who studied the effects of mentoring on teachers' professional development. In his analyses, Dirk Richter found that mentors represent an important learning opportunity that can foster the development of teacher candidates' professional competence—in particular, their motivational development and well-being. However, the quality of mentoring differs substantially between mentors, and it is only mentors who provide instructional and emotional support and who interact with their mentees in a constructivist fashion who have a significant effect on their mentees' development (Richter, Kunter, Lüdtke, Klusmann, & Baumert, in press; Voss, Kunter, & Baumert, in press).

The Uptake of Learning Opportunities After Teacher Training

Given the temporal span of the teaching career, it is clear that the development of professional competence is not completed at the end of the *Referendariat* and that self-regulated professionalization is particularly important during independent teaching practice. In almost all educational systems, teachers' in-service professional education is less strictly structured than their pre-service training. In Germany, in particular, there are few formal regulations on the extent to which practicing teachers are expected to participate in continuing professional development or on the contents to be covered.

Modern views of professional development characterize professional learning not as a short-term intervention, but as a long-term process of engaging in various learning activities throughout the teaching career. Thus, professional development can be defined as uptake of formal or informal learning opportunities that deepen and extend teachers' professional competence. Formal learning opportunities are structured learning environ-

ments with a specified curriculum, such as graduate courses or mandated staff development. They represent a main component of the "training model" of professional development that assumes that teachers update their knowledge and skills by means of workshops and courses. In many European countries and states of the United States, teachers are required to attend such activities on a regular basis. As such, they are the most widely used form of professional development. Informal learning opportunities, in contrast, do not follow a specified curriculum and are not restricted to certain environments. They include individual activities, such as classroom observation and reading professional literature, as well as collaborative activities, such as conversations with colleagues and parents, mentoring activities, teacher networks, and study groups. Participation in these activities is generally not mandatory, but is at teachers' own initiative.

There has been little previous empirical investigation of the learning opportunities used by teachers or of why teachers chose particular forms of professional development. Drawing on our model of competence development, we were therefore interested in the degree to which individual teacher characteristics influence the uptake of particular learning opportunities. In the first COACTIV study, we asked in-service teachers to report on their professional development activities over the last 2 years. We found great variation in teachers' participation in formal professional development courses. On average, teachers participated in 3.5 courses (or 38 hours training) over the 2 years. However, many teachers invested substantially more time in continued professional development and 19% did not report any. We found a systematic link between teachers' motivation and their engagement in professional development courses, with highly engaged teachers participating in more courses. Furthermore, we found that teachers often chose their learning opportunities based on their existing knowledge and interests, rather than trying to overcome deficits (Richter, 2011).

Another study examined teachers' uptake of formal and informal learning opportunities

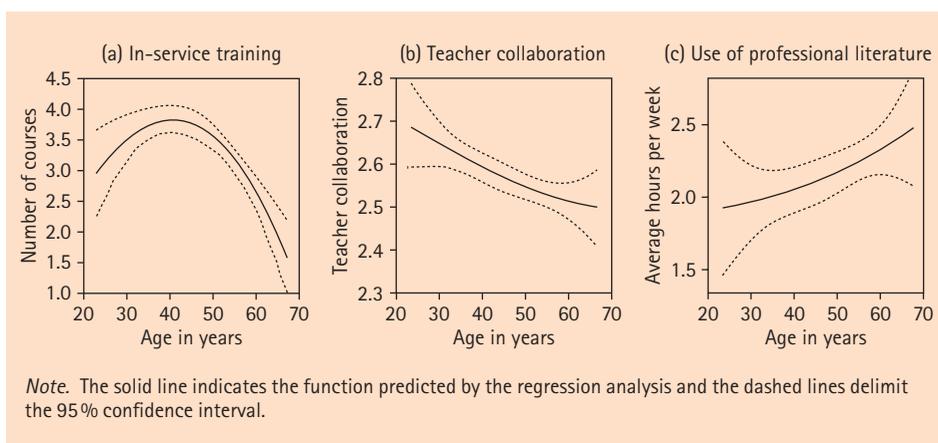


Figure 22. Uptake of formal and informal learning opportunities as a function of teachers' age.

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across the career cycle. Analyses were based on data from the extended COACTIV study, in which 1,939 German secondary teachers were asked about several aspects of their professional life. Results showed that formal learning opportunities (in-service training) were used most frequently by mid-career teachers, whereas informal learning opportunities showed contrasting patterns of use across the teaching career. Specifically, use of professional literature increased with teacher age, whereas teacher collaboration decreased (see Figure 22; Richter et al., 2011).

Summary and Outlook

The COACTIV research program understands professional competence to be those malleable profession-specific individual characteristics such as knowledge, beliefs, motivational orientations, and self-regulation skills that teachers need to meet the demands of their profession. Our analyses show that teachers can differ markedly in their levels of professional competence. Moreover, the empirical data confirm that these differences are reflected in their teaching practice and that all theoretically postulated aspects of teacher competence significantly predict successful teaching outcomes: We found that deep pedagogical content knowledge, constructivist beliefs, enthusiasm for teaching, and the ability to manage personal resources were associated with higher instructional quality and better student outcomes. Our

findings further suggest that the competencies teachers need to provide high-quality instruction and to succeed in their profession can be distinguished from everyday experience and general knowledge. Professional competence is acquired in a process spanning the whole career and involving formal academic training, guided practice, self-regulated professionalization, and, ideally, cooperative continuing professional development. Our findings of systematic differences in professional competence, depending on the school track for which teachers are qualifying or in which they are working, as well as first longitudinal data, indicate that teachers' professional competence is subject to processes of change and that these processes are influenced by the context of training and professional practice. At the same time, it is important not to overlook the relevance of individual characteristics in the uptake of learning opportunities. The recently initiated COACTIV studies on the development of professional competence will continue to address these research questions after conclusion of the Research Center's work, as the researchers involved in the COACTIV program will continue to cooperate closely.

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(last update: February 2011)

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Center for the History of Emotions

The Center for the History of Emotions

The **Center for the History of Emotions** (Director: Ute Frevert) which opened in January 2008 examines human emotions. The research rests on the assumption that emotions—feelings and their expressions—are shaped by culture and learnt in social contexts. A central objective is to trace and analyze the changing norms and rules of feeling. Geographically, the Center's scope includes both Western and Eastern societies (Europe, North America, and South Asia). Special attention is paid to institutions that bear a strong impact on human behavior, such as the family, law, religion, the military, and the state.



Research Staff 2009–2010

Juliane Brauer, Christiane Eifert (until June 2010), Pascal Eitler, **Ute Frevert**, Benno Gammerl, Bettina Hitzer, Uffa Jensen, Susanne Michl (as of November 2009: University of Greifswald, Germany), Margrit Pernau, Jan Plamper, Monique Scheer, Anne Schmidt, Nina Verheyen (as of June 2010: University of Vienna, Austria)

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

Looking at these three faces lacking any sign of emotion, the observer realizes forthwith the absence of something crucial, reducing human beings merely to hollow shapes that need to be filled. When Malevich painted this picture, he had been witness to the Soviets' ambitious and equally violent education experiments. New citizens were to be created with new feelings, new thoughts and actions—but the will and the attempt to shape emotions does not apply exclusively to totalitarian regimes. Democratic societies, too, have attempted to shape people's emotions and impose feeling rules that were meant to facilitate social interaction and individual well-being.



Figure 1. K. Malevich (ca. 1930). Three female figures.
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Introductory Overview

Established in 2008, the Center for the History of Emotions (HoE) aims to explore the various aspects of emotions within the context of time and space. Drawing on the expertise of anthropologists, political scientists, sociologists, musicologists, and scholars working on literature, art, psychology, and education, the group of researchers led by Ute Frevert explores the history and the power of emotions. The Center's specific approach lies in the notion that emotions matter to, and in, human development; they are a result of shaping, of education, on a private as well as on a social level. Who can feel what, when, and where is by no means up to the individual. How emotions are expressed is subject to cultural precepts and proscriptions influenced by family, by the environment at school and at work, by associations and clubs, by religious communities, and by the state and other institutions.

Guiding Assumptions

Work at the Center is guided by two main assumptions. Firstly, we suppose that emotions have a history. Although what psychologists call primary or secondary emotions—fear, joy, hate, envy, trust—were not unknown to earlier generations, those generations differed greatly from us in regard to what they feared, whom they pitied, and what they were proud of. Emotional expression and resulting actions also followed different rules, for instance, a person who was afraid of witches behaved differently from someone who, centuries later, worries about climate change or nuclear disaster. Therefore, the commonly held notion of emotions as an anthropological constant had to be adjusted. The same is valid for the language of emotions: its bodily gestures and facial expressions.

Secondly, we attribute historical power to emotions. Feelings which motivate human behavior and foster the formation of social

groups or movements have always been shaped through interaction. Emotions can be manipulated, heightened, or channeled. What would modernity be without patriotism and national pride, without the addiction to honor and the fear of disgrace, and without communities acting in unison driven by shared anger or hope? Can we imagine a political world, or a world of consumption, without continuous appeals to our emotions? Therefore, the belief that emotions are a purely private matter had to be modified.

Research Areas

A central objective of the Center is to trace and analyze the changing norms and rules of feeling. We therefore look at different societies and see how they have developed and organized their emotional regimes and codes. Research concentrates on the modern period (18th to 20th century), assuming that during this period the way people perceived

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and conceptualized emotions was subject to dramatic shifts. Beginning with a reinforced interest in subjectivity and the emergence of sentimentalism in the late 18th century, another rupture can be noticed in the second half of the 19th century, when especially natural sciences, accompanied by experiences of colonialism, changed perceptions and discourses on emotions, particularly those on civility, barbarism, race, and gendering. The early 20th century saw a third shift caused and intensified by emerging and increasing mass-culture phenomena, redefining the relationship between the individual and society.

Apart from the two guiding assumptions that emotions have a history and make history, our research projects share a threefold theoretical framework. First, we all take into account the intentional and unintentional cultivation of emotions taking place in the various nurturing institutions in family, state, and society. Second, we share the opinion that emotions are felt and embodied in a physical way. This

is a crucial point of contact between us, specialists in various fields of the humanities researching the historical dimension of the body, and our colleagues from the natural and life sciences. Thirdly, researching the history of emotions, we all consider the impact of, and on, power (structures) in society, social groups, and interpersonal relationships. These shared, but differently evaluated, perspectives resulted in the structure of the Center with three research areas:

- Cultivation of Emotion
- Emotion and the Body
- Emotion and Power

Nevertheless, this categorization is not to be understood in terms of borders. Rather, we see researchers, research areas, projects, methods, theories, approaches, and internal and external cooperations within a concept of entanglement. The validity of this concept is mirrored by the projects' geographical orientation, focusing both on Western and Eastern societies (Europe, North America, and South Asia).

Transnational Approach

Our group not only follows an interdisciplinary approach, it also brings together researchers on Europe and India working within a common framework. Transnational history—a history, which no longer takes the nation as its central category, but instead focuses on encounters and entanglements—brings forth a number of challenges. We aim at breaking the hierarchy that traditionally applies to these research areas, according to which knowledge about European history is a prerequisite for Indian researchers, but not vice versa. In our research group, an engagement in both regions is deemed crucial for every researcher. Furthermore, we try to develop a common language and methodology which takes into account the inherent cultural specificities of both regions while, at the same time, offering a ground for general theories.

Collaborative Projects—Publications

From the very beginning, we decided to organize basic research in a collaborative way. One large-scale project was the investigation into the conceptual history of emotions based on two assumptions: Firstly, the way historical actors classified and labeled emotions provides us with insights into how they perceived emotions. Secondly, we assumed that labeling shaped the manner in which emotions were experienced.

Our approach was to collect and analyze articles on emotions and related lemmata that

have appeared in European encyclopedias from the 18th century until today, focusing especially on German, English, and French reference literature. We traced the development of those words ("feeling," "affect," "passion," "sensitivity," "emotion," etc.) in comparison with, and relation to each other in order to discover shifts and ruptures in word usage and meaning, notion, and concept. At the same time, this led us to relevant discourses which are, to a high degree, marked by the gradual eclipsing of several sciences and the substitution of leading sciences, as theo-

logical and philosophical discourses were replaced by medical, psychological, and neurological reasoning. Our results are documented in a monograph about the "Knowledge of Emotions" (*Gefühlswissen*), which describes these changes contextualized preeminently in subject areas related to our specific research projects. In addition to the results achieved in the field of the conceptual history of emotions, the particular projects benefited from this research which, at the same time, sharpened our sensibilities to our present-day use of language. Our publication analyzes the answers (changing over a period of 300 years) on fundamental questions regarding the *conditio humana*, such as: Is the nature of feelings spiritual and mental or physical and material? Which gestures do we use to express emotions and how do others read them? Is there an emotional difference between man and animal? Are there childish and adult emotions? Are certain or too strong emotions dangerous for our health or for politics and society or is it quite the contrary—and sensibility is required especially here? Do feelings divide or connect people? Are they a sign of civility or barbarity, education or the lack thereof? The conceptual history approach enabled us to discover in which way, and how deeply, the knowledge of emotions was, and still is, embedded in the social, cultural, and political structures of modern societies. As a result of another collective project, in 2009 Ute Frevert edited an issue on the "History of Emotions" in the renowned historical journal *Geschichte und Gesellschaft* (History and Society). Six researchers from the Center for the History of Emotions contributed four articles in response to the introductory article "What Has History Got to Do With Emotions?" in which Ute Frevert developed a basic framework for the fundamental problems and questions related to how emotions determine social structures and processes, triggering or preventing particular actions. The article shows that the expression, perception, and interpretation of emotions, such as fear or solidarity, undergo significant changes over time.

Susanne Michl and Jan Plamper (winner 2nd place Thyssen Prize for best article in the social sciences, 2009) focused on the soldierly fear in the First World War, comparing the role of fear and military "trauma" in German, French, and Russian military psychiatry. The contemporary analysis of soldierly fear as an origin of mental illness, its correlations with concepts of masculinity, and specific spaces as the trenches was highly determined by the professional identity of the military psychiatric profession and its relationship to the state. Margrit Pernau investigated civility in the 18th century as a set of feeling rules launching an entangled history of the British discourse on civility (ca. 1750–1860), when perceived differences in feelings became the basis for identifying stages of social development. The "civilizing mission" hence was conceived not only as a transmission of knowledge but even more as the formation of character and the schooling of emotions. Pascal Eitler and Monique Scheer examined "Emotions History as Body History." From a heuristic perspective, their essay argues for the application of theories proved useful for the anthropology and history of the body and of concepts, such as "habitus" and "materialization." Case studies on religious conversions in the 19th and 20th centuries illustrates the usefulness of this approach by analyzing emotions, not as autonomous reactions, but as social practices and techniques. In his article "Love Remembered," Benno Gammerl discusses the possibilities and problems within oral history research on changing emotional patterns and practices. He interprets three biographical narratives and shows how same-sex emotionalities started changing after 1970 as gay and lesbian emancipation gained ground and as the spaces within which same-sex feelings could be practiced, displayed, and performed were enlarged. The Center offered its support (staff and technical resources) for further publications on the History of Emotions. The book *Zwischen Tanzboden und Bordell* (Between Dance Floor and Brothel) presents a number of particularly interesting documents from a history of emotions perspective. Based on a collection of interviews carried out by a

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Basic Research

The history of emotions is one of the fastest growing fields in the discipline of history. *Geschichte und Gefühl: Grundlagen der Emotionsgeschichte* (to be published by German Random House in 2011) is a book-length attempt by Jan Plamper to map what has been done so far and to sketch where we should be heading. It is, in other words, both synthesis and intervention. Most emotions research since the 19th century has been governed by a binary of social constructivism versus universalism, which ultimately goes back to an unproductive opposition of nature to nurture. As Lorraine Daston has put it, coming up with a language beyond this distinction “would require nothing less than the functional equivalent of a discipline’s collective psychotherapy.” *Geschichte und Gefühl* shares this view and offers many glimpses into a posttherapeutic future. The introduction first explicates the binary and its problems and then offers, as background, a thumbnail sketch of influential philosophical theories of emotions.



Figure 2. Facial expressions.

Source. (1) Paolo Mantegazza, *Fizionomiia i vyrazhenie chuvstv* (Kiev, 1886), detail. (2) Photograph illustrating emotions of grief from Charles Darwin's work *The Expressions of the Emotions in Man and Animals*, published by J. Murray, London, 1872. Image courtesy of the Beinecke Rare Book & Manuscript Library, Yale University. (3) Ekman, P., Friesen, W. V., & Hager, J. C. (2002). *Facial action coding system* [CD-ROM]. Salt Lake City, UT: Human Face. (4) Emoticon.

Chapter 1 tries to historicize the history of emotions. It shows that there was historical writing on emotions before Lucien Febvre's 1941 *Annales* article, which is usually invoked as the founding document of the history of emotions. The chapter reviews the contributions of classics of sociology and art history, such as Georg Simmel and Aby Warburg, of 1970s psychohistory, and the history of the family and of Peter and Carol Stearns in the 1980s, whose work helped launch the “history of emotions” as a self-described field. It presents the newest history of emotions, such as that of Barbara Rosenwein, and strives to place this research in larger intellectual and historical contexts. Thus, the current boom of a history of emotions emerges both as a product of the 1990s bio revolution and of 9/11, which cast doubt on poststructuralism's analytical instruments to come to terms with such terrorism-related emotions as fanatical hatred. **Chapter 2** turns to one pole of the binary, social constructivism, and focuses on emotions research from the cultural anthropology perspective. Ethnographies in the 1980s more than anything unsettled the pancultural concepts of emotions and had an enormous impact on historical emotions research. **Chapter 3** turns to the other pole and uses life science research as an emblem for universalist approaches. It reviews prominent paradigms—from Darwin, Wundt, Lange, and James to the latest affective neuroscience—and asks about the consequences of applying these findings to disciplines within the humanities, such as history. The final **Chapter 4** begins by retracing William Reddy's work, a bold attempt to bridge the life sciences and cultural anthropology, and ends by charting prospective areas of historical emotions research. It closes by tackling one of the most vexed questions in the history of emotions, namely, how to include emotion as an explanatory factor—a cause—of past human behavior when emotion words do not surface in the sources, and sketches the outlines of a “hermeneutics of silence.”

prison pastor in 1869, when a reform of the Prussian criminal law was being widely discussed, it offers unique insights into the feelings and lives of Berlin prostitutes. The long and thorough introduction (Bettina Hitzer) places the prostitutes' accounts in different historical contexts, especially of the Protestant endeavors for marginalized groups and of an emerging urban entertainment culture. Furthermore, it investigates the reasons that led women to prostitution as well as what it meant and how it felt to be a prostitute. In particular, the introduction considers the personal experiences and narratives of the prostitutes, something which—due to missing sources—had rarely been taken into account until now.

The history of "male" emotions—emotions ascribed to males or described as manly—was often omitted in master narratives on modern Europe or their history was narrated as a negative one: as a history of repression, of disciplining or of fatal unleashes of male affects. The volume *Die Präsenz der Gefühle (The Presence of Emotions)* co-edited by Nina Verheyen revises this unbalanced perspective, offering 13 contributions by historians as well as philosophers, sociologists, and cultural studies' scholars. All of them reconstruct emotions as an essential element of masculinity, which, aside from historical shifts in its interpretation, representation and articulation, has always been present in modern societies—even if only in terms of affect control as a typical male attribute. Three introductions from different disciplinary points of view deliver systematic insights into the topic. Then, a wide range of empirical case studies, mostly focusing on 19th- and 20th-century Germany, describes and analyzes the relationship between masculinity and emotion in contexts such as marriage, family, friendship, politics, or the military. An epilogue by Ute Frevert contrasts first results with open questions for further research. Manuel Borutta, Nina Verheyen, and Ute Frevert contributed with their introduction and epilogue respectively direction-setting articles. Tracing the grand narratives and definitions of masculinity concepts in history and historiography, Borutta and Verheyen

pointed out that emotions are created and modeled by gendered social norms, varying due to several categories as well as social and situational contexts. They proposed three analytical levels as guidelines: the discourses on emotion, the performative dimension, and the emotional account of male actions.

Ute Frevert sharpened the awareness of the implications of this changing research focus and pleaded for rethinking the relationship between history, emotion, and gender. Granting the diversity of male emotionality charged with tension, dynamics, and frictions, as well as varied interaction between the individual and social institutions and conventions, entails consequences for the exploitation and interpretation of history.

Benno Gammerl opposed the cliché of a distinctive homosexual emotionality. His evaluation of lonely hearts advertisements emphasizes the importance of comradeship instead, which clearly differed from heterosexual lifestyles of intimacy. After 1970 and due to historical changes in the public perception and appearance of homosexuality, he was able to record the increasing pluralization of male emotional styles. But these changes and enhancements in male expressions of emotions also applied to heterosexual men and can therefore be considered as quite independent from sexual orientation.

Pascal Eitler analyzes the contemporaneous emerging of another ideal of new masculinity in connection with the advent of the "New Age." Based on "oriental" religions and techniques of the body, this esoteric movement attributed feelings "originally" to femininity. By encouraging men to discover and develop their "feminine" emotions, the "New Age" movement ended up continuing a traditional comprehension of masculinity in twisted circumstances.

Conferences and Colloquia

The multidisciplinary conference *Doing Emotions: Past, Present, Future* held on the occasion of the Scientific Advisory Board Meeting in 2009 has impressively evidenced the importance and benefit of internal as well as external collaborations among scientists of different research areas and institutions.

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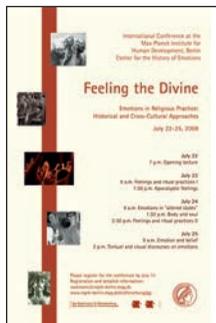
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Monique Scheer

(2009c, September 30). Feeling the divine: Emotions in religious practice—Historical and cross-cultural approaches. 22.–25.07.2009, Berlin [Tagungsbericht]. *H-Soz-u-Kult*. <<http://hsozkult.geschichte.hu-berlin.de/tagungsberichte/id=2794>>



Since a great part of our work consists in the continuous scientific exchange with our colleagues inside and outside the Institute, we often use its infrastructure and open its doors to enable this exchange. In addition to our regular fortnightly colloquium with talks by distinguished scholars from all over the world, the conferences and workshops organized by the Center for the History of Emotions have become an excellent medium for scientific communication and preparation for further cooperation projects.

The Center's first public workshop was an international 1-day conference on Compassion (July 3, 2009) which allowed for productive communication among the varying disciplines of history, sociology, musicology, neuroscience, and theology.

The eminent importance that compassion enjoys in our modern world, the historical and contemporary concepts, the differences to Christian notions or the Aristotelian idea of *eleos*, its function and different kinds of practices (social, aesthetic/musical, etc.), the question of biological or neurological particularities that have to be taken into account, and other aspects were examined in the talks by the main speakers—Thomas Laqueur (Berkeley), Craig Calhoun (New York), Ruth HaCohen (Jerusalem), Tania Singer (Zurich), and Christoph Marksches (Berlin)—from their diverse disciplinary viewpoints. Some of these insightful papers are going to be published in a journal.

On July 10, 2009 Ute Frevert and Nina Verheyen organized the workshop *Morality, Emotions, and Democracy: Rethinking European History* in cooperation with Till van Rahden (The Canadian Centre for German and European Studies/Le Centre canadien d'études allemandes et européennes, Montreal). During the sessions about *Moral Passions in the Enlightenment*, *After Virtue: Beyond Bourgeois Morality* and *Moral History: A Useful Category of Analysis*, the participants had fruitful discussions about key texts from the 18th to the 20th century (Adam Smith, David Hume, Friedrich Nietzsche, Paul Valéry, Theodor W. Adorno, Steven Lukes, and Carl Schmitt). Monique Scheer organized an international conference on *Feeling the Divine: Emotions*

in Religious Practice—Historical and Cross-Cultural Approaches (July 22–25, 2009) with sections on *Feelings and Ritual Practices*, *Apocalyptic Feelings, Emotions in "Altered States," Body and Soul, Emotion and Belief* and *Textual and Visual Discourses on Emotions*. The conference convened anthropologists, cultural historians, religious scholars, and historians of emotions from eight countries. Among the objectives of the meeting: to better understand how emotions are integrated and theorized in religious practice, to debate the status of the physiological correlates of emotion in relation to their semiotic vehicles, and to discuss methodological and theoretical issues around a historicization of emotion and religious experience. The papers spanned a broad spectrum geographically as well as historically and presented material from many religious traditions, allowing for a lively discussion of overarching issues. Participants: John Corrigan (Florida State University); William A. Christian, Jr. (Barcelona); Deirdre de la Cruz (Ann Arbor); Amy Bard (Cambridge, MA); Lehel Peti (Cluj Napoca); Marya T. Green-Mercado (Chicago); Élisabeth Claverie (Paris); Janine Rivière, Amira Mittermaier (both Toronto); Jalane Schmidt (Charlottesville); Ann Taves (Santa Barbara); Gábor Klaniczay (Budapest); Xenia von Tippelskirch (Bochum); Sherry Smith (Hamilton); Knut Graw (Leuven); Anthony Shenoda (Cambridge, MA); Katrina Olds (San Francisco); Angie Heo (New York); Vlad Naumescu (Budapest); Tanya Luhmann (Stanford); Nadeem Shah, Monique Scheer (both Berlin); David Morgan (Durham). The workshop on *Glaube und Gefühl* (Religious Belief and Emotion), organized by Pascal Eitler, Bettina Hitzer, and Monique Scheer took place at the MPI for Human Development on November 20–21, 2009. Focusing on Germany in the 19th and 20th centuries, the discussions within an interdisciplinary group of historians, sociologists, and ethnologists (among others Hubert Knoblauch, Technical University of Berlin, and Thomas Mergel, Humboldt University Berlin) aimed especially at the theoretical conceptualization of the relationship between belief and emotion and revolved around methodological questions.

The organizers are planning the publication of selected papers.

Anne Schmidt organized an international conference on *History, Emotions, and Visual Media* (April 21–23, 2010) with panels on *History and Images*, *History in Public Spaces* and *History and Popular Culture*. In their opening remarks, Ute Frevert and Anne Schmidt contextualized the main questions. The first aim was to test how a more intensive inclusion of emotions as a historical category of analysis can enrich the cultural history research. Secondly, the participants and commentators concentrated on the verification or modification of the widespread tacit understanding that the visual possesses a particular emotional power and effectiveness. Art historians, scholars working on cultural history and literature, and historians tackled these questions in talks which covered a wide span of time and themes.

Participants: Birgit Franke, Barbara Welzel (both Dortmund); Lucas Burkart (Lucerne); Jennifer Montagu (London); Cornelia Brink (Freiburg); Peter Geimer (Bielefeld); Dietrich Erben (Munich); Godehard Janzing (Paris); Jan Plamper (Berlin); Peter Jezler (Basel); Gottfried Korff (Tübingen/Berlin); Juliane Brauer (Berlin); Aleida Assmann (Constance); Billie Melman (Tel Aviv); Tim Barringer (New Haven); Vanessa Agnew (Ann Arbor); Sylvia Paletschek (Freiburg); Jens Balzer (Berlin); Ole Frahm (Kiel).

The conference made clear that historical representations were always intended to evoke emotions, but the assumptions about emotionalizing effects and ideas of emotions were subject to fundamental changes, and so were the practices of the intended emotionalizing and the emotional experiences and perceptions.

Selected papers—including those of Ute Frevert/Anne Schmidt and Aleida Assmann/Juliane Brauer—have been accepted for publication in a special issue of the journal *Geschichte und Gesellschaft*.

Within the context of Pascal Eitler's research project on "Beloved Animals" a conference was held on May 22 and 23, 2010—*Eine Geschichte der Tiere—Eine Geschichte der Gefühle* (A History of Animals—A History of

Emotions) in cooperation with the *Arbeitskreis Geschichte+Theorie* (Work Group History+Theory). Some 40 specialists in history, anthropology, and media analyzed from a historical perspective (18th to 20th century) Animal Studies und History of Emotions as quite new emerging research fields of cultural science. The aim of the conference was not only to contextualize different emotions for different animals (love, hate, etc.) but also to historicize human ideas about the emotions of animals and their capability to feel (pain, love, etc.). In many aspects, the changing emotionalizing of animals, especially in the 19th century, was linked to the changing emotionalizing of humans.

How do we describe and explain the change and the variation of emotional patterns and practices across time and within diverging social settings? The workshop on *Emotional Styles—Communities and Spaces* (July 22–24, 2010) organized by Benno Gammerl explored possible answers to this question focusing on the opportunities (and the problems) presented by the concepts of emotional communities—defined by religion, gender, or other criteria—and emotional spaces—like amusement parks, the office, or the countryside. As the contributions and the discussions demonstrated, examining interactions—conflicts, adaptations, hybridizations—between divergent emotional styles opens up fresh and fruitful vistas for future research on emotions.

In cooperation with the Cluster of Excellence *Languages of Emotion* (Free University Berlin), the Center staged the interdisciplinary conference *Die Bildung der Gefühle* (The Education of Emotions) organized by Ute Frevert and Christoph Wulf. The conference (December 2–4, 2010) started with a keynote by Eva Illouz (Jerusalem) offering *Reflections on Sentimental Education*, followed by 17 talks divided in 6 sections about *Childhood and Family*, *Elementary and Secondary School*, *Peer Groups*, *Work(ing Place)*, *Media*, and *Religion*. The final address on nations as emotional spaces was given by Dieter Lange-wiesche (Tübingen).

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Figure 3. Eva Illouz, keynote speaker at the conference "Die Bildung der Gefühle."

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Internal and External Cooperations

After several initial interdisciplinary conversations, the Harding Center for Risk Literacy (ABC) joined the project "Emotions and Knowledge in Medical Films" with a focus on how risk communication has evolved in educational movies from the beginning of the 20th century to the present. Part of this cooperation is to analyze how health risks are communicated in the specific medium of educational films and which emotions might be targeted by what kind of information. Using such an interdisciplinary approach offers insights from various perspectives into the ways in which films have been used for educating the public, for reforming health behavior, and for managing the public's anxieties and hopes about health and medical interventions. The project will identify



Figure 4. Educational film "Feind im Blut" (Enemy in the blood, 1931 by Walter Ruttmann).

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the historical continuities and changes that took place regarding educating the public about important health issues.

External collaborations often result in jointly organized workshops and conferences, such as: March 12–14, 2009, workshop in collaboration with the Centre for the Study of Developing Societies (CSDS), Delhi: Cultivating Emotion—History, Culture, Society. The workshop succeeded in building contacts between researchers at the MPIB and the CSDS, one of India's foremost institutions for the social sciences. The two institutes share assumptions on the need to bring together European and Indian scholarship on a new basis. The presentations and discussion showed a strong common interest in the impact of emotions on political structures, notably in the fields of nationalism, politicized religion, notions of honor, respect and shame, as well as civility and civil society.

October 4–6, 2010: Conference *Civility and its Other: German, British, and South Asian Perspectives* in collaboration with the German Historical Institute London.

Civility stands for a set of rules governing comportment; this comportment, however, rests on an emotional underpinning, without which it is viewed as lacking in warmth, even as hypocrisy. Real civility thus is seen as based on feeling rules and feeling practices, both of restraining certain emotions (like anger or greed) and of cultivating others (like honor,



Figure 5. Workshop in Delhi, March 2009.

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sensibility, or devotion). Civility thus can only be understood in relation to its other; the reference to non-civil feelings and behavior is always an implicit presence. At the same time, these demarcations are not stable, as feelings and behavior which are generally excluded from the concept (like anger and violence) may well be justified, implicitly or even explicitly, as being part of this concept under certain circumstances (righteous anger, violence in the colonies, war ...).

Introducing History of Emotions in International Networks on Conceptual History

We regard conceptual history as an important tool for the history of emotions. At the same time, this permits an enlargement of conceptual history's traditional scope whose major projects have until now centered on political and social concepts. Therefore, we have established close contacts with the History of Political and Social Concepts Group (HPSCG), the international association for conceptual history. Besides taking up the coeditorship of the association's journal, *Contributions to the History of Concepts*, Margrit Pernau has organized the following events:

September 17–20, 2009: Panel at the annual conference of the HPSCG in London: *Toward a Historical Semantics of Emotions*, in collaboration with Sinai Rusinek, Van Leer Institute Jerusalem.

September 16–19, 2010: Panel at the annual conference of the HPSCG in Moscow: *Conceptual History and the History of Emotions*.

August 3–19, 2010: International Summer School: *Introduction to Conceptual History* (Concepta in collaboration with the University of Helsinki).

The Summer School, which brought together for the first time 30 doctoral students from 3 continents, included sessions on emotion-concepts, which were very well received by the students.

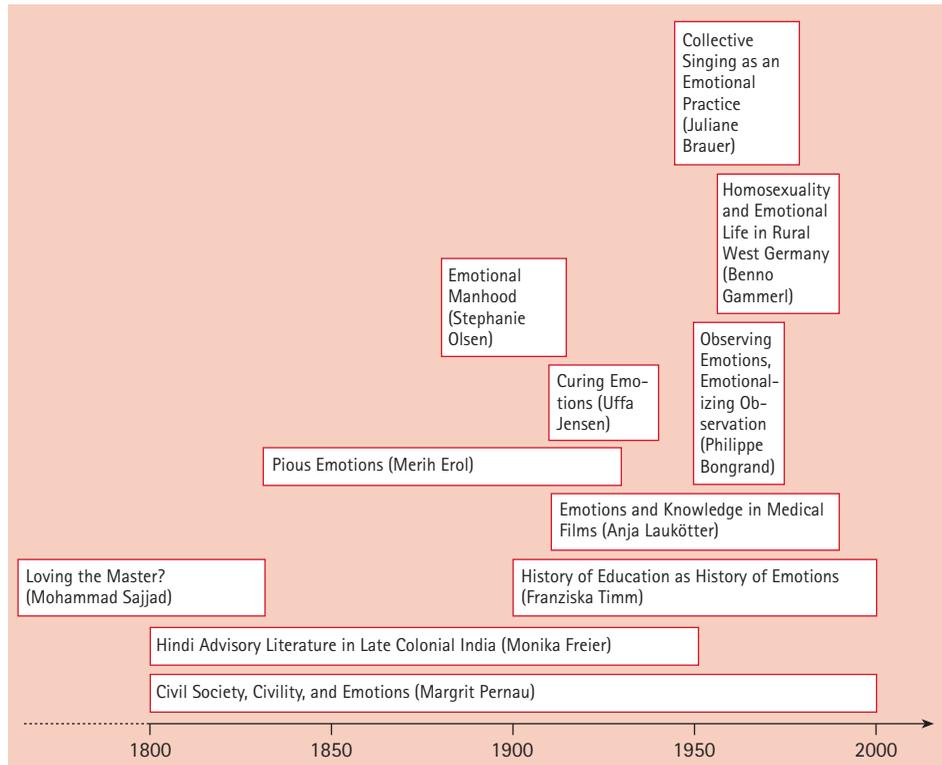
Research and Teaching Network With the University of Chicago

Since the research group was set up, close research contacts have been established with the University of Chicago, notably the Department for South Asian languages and civilizations. This led not only to mutual visits but also to common projects within the fields of conceptual history and film studies. Three colleagues from Chicago, Dipesh Chakrabarty, Rochona Majumdar, and Orit Bashkin, will be involved in the Civility Network project, which will take up its work in 2011 (see below for a detailed description p. 136 f.).

2011 will also see the first steps toward a cooperation at the level of training graduate students, as three of the Center's predoctoral fellows have been invited to a research training seminar in Chicago.

Initial preparations are under way for a collaborative project on "The emotion from the private to the public sphere (19th to 21st centuries)" initiated by the Centre d'Histoire Culturelle des Sociétés Contemporaines (CHCSC) of the University of Versailles St-Quentin en Yvelines. Alongside other research institutes in Paris (among which the HAR-Centre Francastel—Université de Paris Ouest Nanterre la defense, Institut Français de presse—Université de Paris II, and Centre Identités Cultures Territoires—Université Denis Diderot), our Center will participate in the work that will lead to a colloquium in April 2012 with the aim to scrutinize and analyze the flux and reflux of emotions between the private sphere on the one hand, observed for instance in private correspondence, and the public arena on the other, as encountered for example in different forms of media.

Research Area: Emotion and Cultivation



The ways in which people experience and express their emotions and how others perceive and respond to them are subject to cultural rules, do's and don'ts. In this research area, the focus lies on the conscious and unconscious shaping and formation of emotions within institutions, such as family, school, religious organizations, the military, and other social settings. The projects examine how people were brought up to have certain feelings, to show or to suppress them, what conventions were created in this manner, and which consequences occurred for the individual and their social environment.

Researcher
Margrit Pernau

Civil Society, Civility, and Emotions: Britain and India Since the 18th Century

During the period under review, the project has developed along three lines: First, civility and civilization are concepts linking knowledge on emotions to morality, on the one hand, and to political structures, on the other. Civility was a notion which allocated individuals a place in society—it was their civilized way of feeling, restrained but authentic, which distinguished the middle classes from the nobility as well as from the lower classes after the beginning of the 19th century. Civilization, in turn, based on the idea of stages of development, gave each specific society its place on the time scale of

historical evolution. The distinction between civilized and barbarous nations was crucial for the creation of a global hierarchical order in the colonial age. This distinction was centrally based on the study of character, first by travelers, then by the new disciplines of ethnography and anthropology, and finally by psychology, notably *Völkerpsychologie*. A character, in turn, was a shorthand for habitual emotions—nations and races were distinguished as much by the color of their hair and skin as by their basic emotional makeup. Second, in the wake of the seminal work on the civilizing process by Norbert Elias, civility has generally been held to consist mainly



Figure 6. Abdullah Qutb Shah—7th King.

Source. Raza Alikhan, Hyderabad—A City in History, 1986.

in the repression of emotions considered destructive by society. From the beginning, the project had aimed at enlarging the scope, considering not only the repressive but also the creative aspects involved in the process of civilization. It now turns out that it will be necessary to go even further. Indian rulers are very often portrayed holding a rose in one hand (a symbol of their refinement, their appreciation of beauty, and their ability to be impressed by softer feelings) and a sword in the other. The symbol of the sword remains ambivalent, as it can be interpreted as the enforcement of justice but also as the valuation of emotions deemed destructive in other contexts: Righteous anger, even rage, and the ability to induce fear were considered noble and royal qualities. The investigation of the concept of anger, therefore, seems a necessary part of the study of civility. Third, in cooperation with Professor Helge Jordheim (Oslo University), a proposal was submitted for a research network on “Civility, Virtue and Emotions in Europe and Asia: History of Concepts as Entangled History From the 18th Century to the First World War.”

The aims of the project can be summed up in three points: (1) To bring together the history of civility with the history of emotions in a systematic way, (2) to study the semantic field of civility as a way of understanding processes of colonization and globalization in the 18th and 19th centuries, and (3) to work out the interaction between concepts emanating from Europe and concepts in the different Asian languages and to investigate their entanglement. The project focuses on Europe and Asia, regions with a long history of intense entanglement reaching back to the 18th century. The countries included with research projects of their own are Great Britain, France, Germany, and the Nordic Countries, on the one hand; and the Ottoman Empire both with its Turkish and Arab regions, Iran, India with separate projects on Urdu, Hindi, and Bengali sources, China, Japan, and Korea, on the other. The researchers have already started to work on their respective projects, so that first results can be expected at the kickoff conference in October 2011.



Figure 7. Contemporary illustration of a battle during the revolt of 1857.

Source. Gilliant, Edward (1914). *Heroes of the Indian Mutiny*. London: Selley Service & Co., p. 342.

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Observing Emotions, Emotionalizing Observation: Children's Emotions and School Assessments in France During the 1950s and the 1960s

In the past two centuries, school issues have acquired growing importance in numerous Western societies. In order to research the dynamics and forms of this complex schooling process in the French case, the 1950s and 1960s are of strategic interest. Pupil numbers "exploded" as more and more opted for postcompulsory education, and the average duration of schooling was extended. Professional education spreads in new territories, such as management or agriculture. The French State doubles the education budget and proceeds to substantial reforms for a "rational" educational system. School acquires an enhanced role with regard to social mobility: "democratization" debates emphasize this brand new hope for education and, therefore, school policies. Seen as a whole, this multidimensional schooling process links together social stratification, sciences, and political order. Inspired by Norbert Elias, it can be hypothesized that it also has implications on the "individual" subjective life. What kind of specific subjective economy does this schooling process raise? Does it structure, foster and/or rely on particular emotional features and through which mechanisms? In other terms: Does the schooling process

take part in creating a particular emotional regime—a schooled emotional regime—a schooled emotional regime? Such are the starting questions in the heart of the research project.

The main hypothesis arises from the fact that the unification of educational institutions expands the role of schooling beyond educating to orientating children within the "system." Teachers are therefore urged to teach and guide children according to their personality, desires, and academic skills. Special training and pedagogic literature offered the scientific background for their brand new mission: "observing" children. The first part of the project consists in investigating these professional guidelines: How do they take children's emotions into account? The case of the short-lived but significant success of the characterological branch of child psychology will be particularly investigated. The second part of the project deals with the children's point of view: How did children experience being "observed" and having their personalities assessed? Egodocuments, such as pupils' diaries, will shed light on this question. The third part of the project is devoted to the interaction between educators and children in schools. Drawing from records of school practices, the project aims to identify the features of an emotional work shared by adults and children at school. Each part of the project focuses on emotions in comparison with pupils' "intelligence," "knowledge," and "skills." Assuming that French society is still deeply marked by a great divide between emotion and reason, an investigation on the schooling process may specify the role of schools in the (re)production of this distinction. The project thus aims to investigate the political, scientific, and social fabric of the intimate.



Figure 8. "His predispositions may turn his school concern to despair." How a rearing guide teaches educators how to cope with children's emotions.

Source. Le Gall, A., & Bijon, M. J. (1996). *L'enfant: Conception, enfant, adolescence*. Paris, Librairie Larousse, p. 148.

Collective Singing as an Emotional Practice: Music Education and Youth Culture in the German Democratic Republic (GDR)

The project examines the interconnection of music education and the formation of feelings with particular focus on the GDR. Music education includes both music in schools and extracurricular musical activities organized by the state children and youth organization, the *Freie Deutsche Jugend* (FDJ). The research project focuses on the following questions: Which emotional repertoire did the East German educational system promote in children and youth during which period and with what justification? Which theories on the emotional effect of music was music education based on and which methods of inducing the desired emotions emerged as a result? How dominant was the emotional style defined and transmitted by music education?

There are two advantages in this approach. First, the GDR is a particularly suitable research subject, as the GDR literature for music educators explicitly states which emotions should be awakened in students, discusses the importance of singing together for this purpose, and outlines the practical consequences for the classroom. Second, the question of a politically defined emotional repertoire sheds light on aspects located at the interstices of the themes that are dominant in academic research, such as dictatorship, repression, and resistance in the GDR.

Initially, the project aims to scrutinize traditions of bourgeois and social democratic singing movements from the 19th century up to the National Socialism era concerning underlying aims of shaping emotions. Based on this outline about collective singing as an emotional practice, the project will then focus on music education in the GDR until the end of the 1960s. Until around 1970, most discussions concerned the aims of music curricula and the integration of music education into socialist education. Some first observations on the relevant repertoire of songs already highlight a number of conceptions of feelings related to central aspects of socialist moral education, including feelings of homeland solidarity and group identity. To emphasize

the specifics in the GDR, it is necessary to compare it with music education programs in West Germany concerning shaping desirable emotions.

The third part will focus on the ways in which communal singing was staged by the FDJ between the 1960s and the 1980s. The organization and choreography of school celebrations and ceremonies will be analyzed, complete with audio and video documentations of events, festivals, and (inter)national choir or youth meetings. Furthermore, it is necessary to have a closer look at the development of the youth *Singebewegung* (sing-a-song movement), which was influenced by Folk and Beat music. Around 1970, up to 80,000 young people were supposedly active in the *Singebewegung*. Despite the state control, an individual musical language was developed in the FDJ *Singeklubs* (sing-a-song clubs). The concluding part of the project will focus on the interplay of dominant and subculture musical practices and the emotional styles mirrored by them. Therefore, it will examine alternative singing practices within youth subcultures in the GDR, such as Rock or Punk. Comparing these with singing practices and songs of the youth protest movements in West Germany, such as the students' or the peace movement, will offer insights into specific singing practices in the GDR.

Researcher
Juliane Brauer



Figure 9. "Ich liebe mein Land," Poster of the FDJ: 35 years GDR in the songs of the FDJ.

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Researcher
Merih Erol

Pious Emotions: The Formation of the "Ethical Self" in the Greek Orthodox Populations of the Ottoman Empire and Greece (1830–1930)

Empirical research does not necessarily prove the impact of religion on the development of a moral self; however the moral emotions often addressed by psychologists, such as shame, guilt, remorse, regret, etc., are embedded in the long social and psychological history of religion. The project explores the processes of the formation of the "ethical self" in the 19th-century Greek-speaking literate urban populations of the Ottoman Empire and the Greek state, with a special interest in the role of motives, emotions, attitudes, and dispositions linked to piety. It analyzes the changing conceptualizations of ethical behavior and moral conflicts among the Greek-speaking literate strata of three cities, Istanbul/Constantinople, Izmir/Smyrna, and Athens.

The history and aspects of the ethical self will be traced in view of (a) the contemporary

discourses (secular, religious, and those with nationalist overtones) on the ethos and the emotional setup of the ethical individual; (b) the ecclesiastical and monastic discourses on notions, such as sin, salvation and penance, and the practices of reconstruction and cultivation of emotions that are closely connected to notions of piety and religious ethics; and (c) the contemporary theological and nontheological discourses on the soul and on issues like the role of "reason" and "will" in fighting against the passions, desires, and

appetites of the soul. The project draws on the following disciplines and research fields: cultural history, social anthropology, sociology of religion, history of ethics, and history of emotions.

Regarding its comparative agenda, the project seeks to explore the different expectations that the contemporaries had from public education and private upbringing in the multiconfessional society and the *millet* system of the Empire, on the one hand, and in the relatively homogenized society and the particular legal and institutional framework of the nation state, on the other.

The project is a pioneering attempt at filling the gaps in the current research, considering both the study of historically significant changes in the moral imagination and the conceptualizations of moral behavior in the Greek orthodox populations of the region (existing studies mostly approach the issue from a social anthropological perspective) and also the study of theological and nontheological conceptualizations of the soul, the will, the mind/body dichotomy, and their relationship with the emotions.

The broad range of source material that will be examined consists of (a) the published and unpublished material of the official religious institutions (the circulars and minutes of the sessions of the Holy Synod of the Church of Greece and of the Patriarchate of Constantinople, collection of ecclesiastical texts commented and published by the monks of Mount Athos, ecclesiastical periodicals); (b) the sources of the nonofficial religious institutions, that is, movements and brotherhoods (texts written by the religious movement leaders, periodicals); (c) sources that might offer insights into the popular conceptualizations of piety and the moral imagination in the urban populations that are under scrutiny (accounts of the celebrations of orthodox feasts and the feasts of local saints; the popular publications about the lives of the Christian saints, novels, memoirs, autobiographies, etc.); and (d) literature on child and adult education, focusing on moral emotions and moral behavior (speeches and texts of school directors, teachers and other experts, and ethical guides).



Figure 10. Book cover of Dionysios Pyrros' book entitled *Morality in Childhood and the Ethics of Man* (Nafplion, 1829).

Homosexuality and Emotional Life in Rural West Germany (1960–1990)

"In DER zeit war's 'ne STRAFE (.) so zu sein. (.) und heute, heute ist es 'ne FREUDE"—"in THOSE days it was a PUNISHMENT (.) to be like that. (.) and today, today it's a PLEASURE" (Ms. Jäger, interview 2, sequence 558). This is how one interviewee describes the fundamental shift in perceptions regarding same-sex desire that occurred between 1970 and 2010. The research project questions how emotional patterns and practices amongst men-loving men and women-loving women changed during this process. The analysis draws chiefly on two kinds of sources: gay and lesbian magazines from 1960 to 1990 and oral history interviews with 15 women and 17 men, born between 1935 and 1970. These conversations have been recorded and transcribed over the past 2 years. About one third of them so far has also been summarized and coded. For this purpose, the data are processed in ATLAS.ti which allows for thematic indexing and facilitates the search for narrative and argumentative patterns. The first findings have already been discussed with colleagues from the field of queer studies (Antwerp, March 2010) and with fellow oral historians (Prague, July 2010). From the analysis, three distinct generational types have emerged: the homophile (born around 1940), the movement (born in the 1950s), and the lifestyle (born in the late 1960s) generation. In addition to the onset of the gay and feminist movements in the 1970s, further developments were crucial for this typology: the flourishing of new gay and lesbian media, the fundamental shift in gender relations and the collapse after 1970 of up to then stable social milieus as well as the spread of HIV and the upsurge in therapeutic and esoteric technologies of the self after 1980. Two emotional shifts have been identified so far. Firstly, journals and life narratives show that falling-in-love stories marked by suddenness and immediacy were replaced by detailed narrations elaborately recounting how and why a relationship started. The older pattern was closely linked to the fact that only limited and unsafe spaces were available for the dis-

play of same-sex desire before 1970; the latter pattern emerged through the new niches for practicing same-sex intimacy carved by the gay and lesbian communities. Secondly, while younger interviewees put their partnerships center stage when they talk about feelings, older respondents accord equal emotional relevance to a variety of topics, ranging from family across to spirituality and feminism (see Figure 12, where the thickness of the linking lines indicates the larger or smaller number of certain topics co-occurring within the interviews). This finding corresponds with the wider notion of "love" used by women from the movement generation as well as with the distinction between "love," and sexual encounters prevalent among homophile men. In contrast, when members of the lifestyle generation speak about "love," they mostly refer to partnerships that combine emotional and sexual elements. These observations indicate how changes in the social and cultural perceptions of same-sex desire and diverging homosexual identity formations shaped historically specific emotional patterns and practices, a correlation that the project will explore further.

Researcher
Benno Gammerl

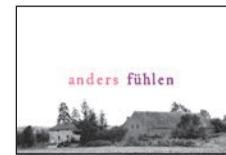


Figure 11. Logo of the project "anders fühlen."

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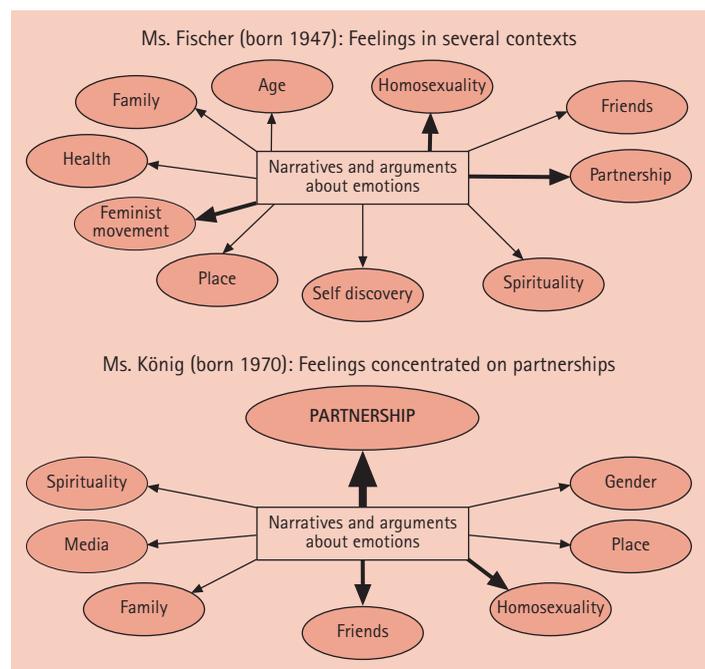


Figure 12. Thematic contexts of feeling sequences in two interviews.

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Researcher
Uffa Jensen

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

In many different societies of the early 20th century, psychoanalytical knowledge shaped the way in which people discussed, understood, and experienced emotions. Therapeutic cultures, at first established only in various metropolitan settings, created new ways of treating emotions as part of curing mental disorders. At the same time, these therapeutic cultures spread psychoanalytical knowledge beyond the clinical sphere. Popular psychoanalysis generated new discourses on emotions in the general society. Here, the management and control of emotions was propagated and advanced for individual use in everyday-life situations. The project examines these developments in Berlin, London, and Calcutta. While the first full-fledged formation of a therapeutic culture with a substantial popular appeal emerged in Berlin (i. e., apart from Vienna), London was decisive for the transformation and translation of psychoanalytical knowledge into an English-speaking cultural and linguistic context. Calcutta was the first non-Western branch of the psychoanalytical movement and also the site of a comprehensive therapeutic culture where psychoanalysis was surprisingly popular. In all three cities, lively theoretical debates about psychoanalytical concepts and their relevance took place among local psychoanalysts, psychologists, psychiatrists, and medical

and other specialists. Moreover, these debates were closely related to therapeutic practices in hospitals, institutes, and private clinics, which were founded (more or less) specifically for psychoanalytical treatment in the three cities. Finally, a popularized form of psychoanalysis was disseminated to the reading and listening public of these metropolitan centers. Emotions increasingly became the subject of theoretical debates. They featured significantly as part of the symptoms of mental disorders and thus shaped the therapeutic activities. Lastly, they were a major topic in the popularization efforts. The

project will examine these different levels using a broad variety of German, English, and Bengali sources: Discursive sources (theoretical discussions among psychoanalysts as well as popularization material, like books, pamphlets, journal and newspaper articles, etc.), institutional records (i. e., from various associations, institutes, hospitals, etc.), as well as private papers (letters, diaries, memoirs, etc.), revealing, in particular, individual patterns of acquisition and usage of this knowledge. Psychoanalytical knowledge was adapted to the different urban settings and thus changed through these processes. In the resulting dissimilar *psychoanalyses*, emotions functioned as a marker of difference because they depended heavily on culturally different assumptions regarding selfhood and culture. At the same time, however, psychoanalysis also created a traveling culture. The internationalization of the psychoanalytical movement enabled the exchange of theoretical knowledge, therapeutic practices, and popularization efforts, as well as mobility among the practicing psychoanalysts themselves. A transnational debate emerged concerning those cultural differences which had become visible through the adaption of psychoanalytical knowledge. Thus, psychoanalysis became an important transnational mode to compare different notions of selfhood and culture. Here, the role of emotions is still open to debate: Did emotions function exclusively as markers of difference between various cultural settings? Or did psychoanalysis also create a transnational mode of experiencing and thinking about emotions?



Figure 13. Lumbini Park Mental Hospital.

Source. Anonym. Lumbini Park Silver Jubilee. Kalkutta (1966).



Figure 14. Consultation room in the psychoanalytical clinic in Berlin.

Source. Brecht, K. et al. (Eds.). (1985). "*Hier geht das Leben auf eine sehr merkwürdige Weise weiter ...*": Zur Geschichte der Psychoanalyse in Deutschland. Hamburg: Kellner, p. 47.

Emotion and Knowledge in Medical Films (1910–1990)

Having started in April 2010, this project will show why and how emotions were used to communicate knowledge on the body in educational and medical films. Already by the end of the 19th century, medical sciences were using the medium of film as a research instrument, which allowed new insights into the body. Additionally, the potential of this new technique was used for the transfer of knowledge to a broader audience. Especially in Europe and the United States, a large number of medical films was produced to inform the public about diseases, such as tuberculosis, cancer, and syphilis. Alongside many differences, we find strongly comparable developments and manifold transfers in the history of medical films in Germany, France, and the United States. Especially within these countries, the practice of a circulation of specific medical films was very lively; these films oscillated between global demands and national/local viewing habits. The project's starting point for a strong transnational perspective is the German developments. Within the research period from the beginning of the 20th century till the 1980s, these films changed in their form of narration, picture aesthetics, and dramaturgy to communicate knowledge on the body in an emotionally appealing way. The project will focus on films which deal with sexually transmitted diseases primarily, as films on contagious diseases turn out to be an experiment space for film developments offering stories on "sex and crime." Moreover, these films appear from the very beginning of film production: from French syphilis films for the armed forces, gonorrhea films in the Weimar period, American tripper films, to GDR Aids films in the 1980s. Overall, the project works on three levels: (1) *Narrating Emotions*: Firstly, it analyzes the relationship of emotions and knowledge in the discourse on the potential of these films. Since its invention, the value of cinematography for medicine has been widely discussed. Within the scientific context, it was regarded as a tool for objectification with a de-emotionalizing effect. On a similar euphoric

level, but with contrary results, its potential as a technique to mediate knowledge to the public was discussed across professional boundaries. Directors, physicians, lecturers, and others sought to improve society and public hygiene through the popularization of medicine and films. They envisioned health education films as health issues with the use of spatially invasive (reaching everybody everywhere) mobile projectors and as a powerful tool to influence the psyche which leads to a change in behavior.

(2) *Filming Emotions*: Secondly, the project will explore practices of "emotionalizing knowledge" in films by focusing on which techniques are used to mediate knowledge of the body, and which role emotions play in doing so. Thus, specific techniques of visualization (such as microscopic views, statistics, diagrams, clinical pictures) and specific techniques of exposure (such as montage, close-ups, fast/slow motion, use of fictional scenes) will be analyzed regarding their emotional impact. Special attention will be paid to films which were circulated (with or without alterations) in different countries to research the transnational impact of specific emotions. (3) *Controlling Emotions*: Thirdly, the project will analyze how and why instruments designed to control the emotions evoked by films were developed in the 1910s and became commonplace throughout the research focus period. In that context, the institutionalizing of censorship which represents an attempt by the state to control the emotions and fantasies engendered by these films is of great interest. Further control techniques to explore are scientific audience research projects which tried to measure the emotional effects of films on audiences in experimental settings.

Researcher
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Figure 15. German "Hygiene Car" for Film Projection in Rural Regions (1951).

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Researcher

Stephanie Olsen

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Emotional Manhood: Adolescence, Informal Education, and the Male Citizen in Britain, 1880–1914

The mass voluntarism of 1914 in Britain has been understood as an acute outpouring of the prevailing jingoistic and militaristic currents of the late Victorian and Edwardian eras, combined with an unrealistic optimism about the likely duration of the war. This established interpretation has allowed other explanatory factors for why so many young men rushed to the call to arms to go overlooked or remain underexplored. A major focus of the project is to reinterpret the events of 1914 according to widely felt emotions related to moral and domestic duty (of loyalty to family) through a sense of character and temperance defined in Christian terms. These, in turn, were related to religious outpourings of emotion.

Appeals to emotion and the shaping of “correct” emotional responses on these important issues were key to the shaping of the next generation of men. This *informal* moral and emotional education was carried out through the medium of popular culture and youth organizations. The project ties the historical

study of emotions with an examination of some of the fundamentals of society and the individual's place in it: family, religion, and citizenship. The definition of citizenship here represents the historical multivalence of the term, including its emotional resonance. Crucially, it was associated with future fatherhood: Good heads of families would be good citizens. In addition, the project examines how the increasing professionalization of disciplines related to childhood—education, social work, and

especially psychology—changed the nature of informal education for boys and impacted popular conceptions of boyhood and adolescence.

The major sources for the project arise out of a variety of religious organizations that focused on the temperate and manly upbringing of boys, from the Religious Tract Society, to the Church of England Temperance Society, and the Band of Hope. My work also establishes ideological similarities between these groups and for-profit publishers, such as the Amalgamated Press, all of which promoted their ideas through the youth groups they organized and perhaps, even more pervasively, through the written word. Results so far reveal consensus amongst the publishers of juvenile literature that children (especially boys) of all areas and social backgrounds were being failed by the various institutions of formal education (be they the elite public schools or the new schools springing up since the Education Act of 1870) and that certain moral imperatives were being inadequately met by the nation's parents. Stressing the continuity of religious influence in the everyday experience of children throughout the late Victorian and Edwardian period, I have charted the agreement established between disparate groups on the importance of disseminating Christian values for the task of raising the nation's boys into manly domesticated men and good fathers. This emphasis on family life is crucial, since it broadens the current historiographical focus on the imperial connotations of elite education and the supposed middle class “flight from domesticity.” By showing that masculinity was not only about patriarchal or imperial outlooks, but also about emotional attachment and loyalty to family, the work explicates the meaning of fatherhood in the period, stressing the continuing importance and validation of men as fathers and of the boy “as father to the man.” This, in turn, is used to explain what appeared at face value merely to be a mass outpouring of militaristic fervor in 1914 that can alternatively be seen as an emotional outpouring based on association to family, to community, and often to Christian cultural continuity (even in a so-called secularizing society).



Figure 16. Savile Lumley, Parliamentary Recruiting Committee Poster, London, 1915.

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Hindi Advisory Literature in Late Colonial India

Taking a peak at the bookshelf of an average middle-class household in today's India, one is more likely to find books on how to become successful in business, win friends, or develop self-confidence, than novels or even poetry. The research project traces the beginnings of advisory literature in India that developed in the second half of the 19th century up to its blossoming in the 1930s and 1940s. This was a period of heightened literary activity for Hindi, which became the medium of discussion concerning cultural, moral, and religious issues, along with a language movement that resulted in Hindi becoming the national language of independent India. Reformers, literati, and laypeople wrote advisory literature in all kinds of shapes and sizes: etiquette books, domestic advice manuals, religious tracts, and instructive schoolbooks on moral education.

By analyzing these normative works and the circumstances of their creation, the research project traces processes of community formation following the lines of norms and regulations for feeling and the expression of emotions. Reading Hindi advice manuals as a cultural phenomenon shows the creation of an emotional landscape along the lines of culture, religion, and questions of national identity. The "westernized" school system came under harsh criticism due to fear that this kind of education—and the modernization it promoted—would corrupt the values and norms of Indian society. At the same time, translations and adaptations of British self-help books became increasingly popular, and advice books in Hindi frequently cite current psychological research along with ancient texts of Hinduism in order to legitimize their authority. The authors of these books not only hoped to reform their readers through practical advice on matters of daily behavior and conduct but also aimed at offering them an education of the heart. Tracing emotions and looking at how they matter, for the individual as well as for society as a whole, casts a new angle on historical research.

The qualitative content analysis of the sources accounts for different levels:

- Normative rules and regulations for feelings and their expression; relating, for example, to the gendering of emotions in the sphere of domestic love but also on a broader societal level, such as discussions on greed, anger, and fear in business and interpersonal contacts.
- The conceptualization of emotions in the body as well as the need for emotional control and equilibrium, such as the idea of *brahmacharya*, that is, abstinence from (sexual) passions.
- Legitimizing of emotional rules by nationalist, religious, or scientific authority.

All these aspects figure prominently in the primary sources that have mainly been collected from Indian libraries. Additional archival material, such as reports by the British Government and contemporary literature has been accessed in the British Library (funded through a grant by the German Historical Institute, London).

The first results of the ongoing research project were presented as papers at the European Conference of Modern South Asian Studies (July 2010, Bonn) and the interdisciplinary Conference "Bildung der Gefühle" (December 2010, Berlin), as well as on several internal and external workshops.

Researcher
Monika Freier

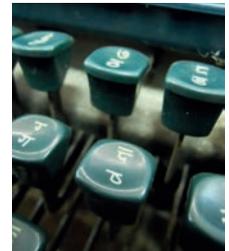


Figure 17. Detail from an old Hindi typewriter.

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Figure 18. Reading room of the Arya Bhasha Pustakalay (Library), Benares, with portraits of famous Hindi writers and social reformers.

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Researcher
Mohammed Sajjad

Loving the Master? The Debate on Appropriate Emotions in North India ca. 1750 to 1830

The project explores the emotions underlying the love relationship between the Sufi master and his disciples in Islamic mysticism during the transition period from the 18th to the 19th century. During this period, the reformist scholars and the Sufis debated the nature of this relationship as well as related emotions and customary Sufi practices. The project focuses on the conceptualization of emotions and formulation of emotional rules, reception of the classical Sufi texts, and contestations over key concepts of emotions.

So far, two conference papers have been presented: *Concept of the Soul: Sufi Scholars in North India, late 18th to early 19th Centuries* (London), and *Purifying the Soul: Conceptualizing Emotions by Indian Sufis* (Bonn). In Bonn, the researcher also coconvened a panel on *Sufism and the History of Emotions*.

Unlike the Western concepts of emotions, the sources indicate that emotions are conceptualized as states of the heart or the soul.

There is no umbrella term to describe emotions. They are discussed under the rubrics of passions, desires, moral qualities, attributes, mystical experiences and states in the contexts of divine love, purification of the soul, refinement of moral qualities, and musical audition. Emotions are generated through the interaction of the heart, soul, spirit, and intellect. According to the Sufi scholars of this period, the faculties of emotions are given, but they can be refined and controlled both

by individuals and by socialization or imitation in the Sufi hospices and in society. The disciples are supposed to follow certain norms for the cultivation of positive emo-

tions and suppression of the negative ones. The findings of these two papers have been crystallized in an article, ready for publication. Two additional conference papers have been presented: *The Master-Disciple Relationship in Indian Sufism* and *Allegiance to the Master: Conceptualizing Spiritual Authority* in Berlin and Oslo, respectively. The sources reveal that the disciples are required to cultivate love for the master to tread the spiritual path to God, but love is a contested concept. This contestation reflects the ideological background of the Sufi scholars and the sociopolitical situation of the time. Shah Isma'il, a reformist scholar, describes two types of love: love of the soul and love of the intellect. His description falls in line with the program of his movement which aimed at socioreligious reform and political activism. Hence, he prescribes emotional rules, which, unlike those of other Sufis, were based upon his evaluation of contemporary sociopolitical concerns. However, he was opposed by other Sufi scholars. The sources also reveal how the Sufis and scholars appropriated the concept of the oath of allegiance a disciple pledges to his master in the context of the transition period.

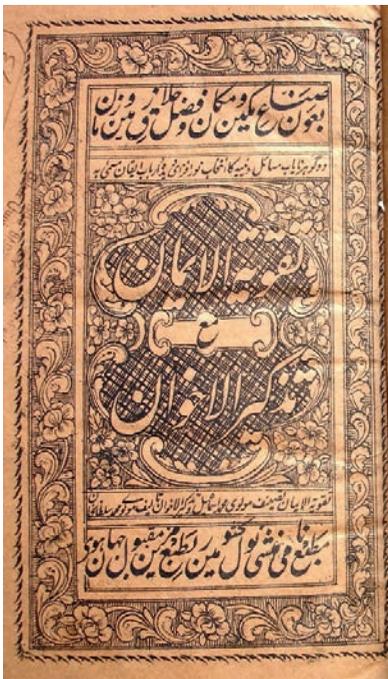


Figure 19. A reformist tract by Shah Muhammad Isma'il (d. 1831) of Delhi. It deals with issues, such as monotheism, polytheism, intercession and customs, and Sufi rituals which are deemed as un-Islamic.

Source. Title page of *Taqiyatul Iman wa Tadhkirul Ikhwan* (Strengthening the Faith and Admonishing the Brethren) published in 1876.

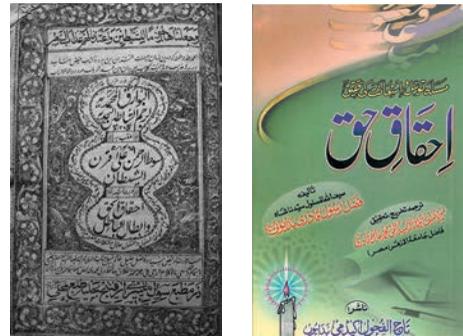


Figure 20. These two counter-reformist tracts by Shah Fazle Rasool Badayun (d. 1872), criticize many of the arguments of the reformists and deal with monotheism, polytheism, and intercessionary roles of the saints and the prophets.

Source. (left) Old Title page of *Ihqaq al Haqq wa Ibtal al Baatil* (Verifying the Right and Falsifying the Wrong) published along with *Al-Bawariq Al-Muhammadiyya Li Rajm al-Shayatin al Najdiyya/Saut al Rahman 'Ala Qarn al Shaytan* (The Mohammadan Lightening for the Stoning of the Satans of Najd/Divine Scourge on the Horn of the Satan [Persian] ca. 1848). (right) New Title Page of *Ihqaq al Haqq wa Ibtal al Baatil* (Urdu), by Shah Fazle Rasool of Badayun, published in 2007.

History of Education as History of Emotions: The Pedagogic Eros in the 20th Century

This research project—originally planned as a dissertation—aimed to develop a more thorough understanding of pedagogic Eros focusing on four historical and systematic levels:

(1) In the course of the 20th century, scientific discourses show a tendency to displace pedagogic Eros from educational theories. Contrary to the progressive educational movement, the advocates of liberal arts' pedagogy denied its legitimacy because the subjective and emotional nature of such an educational relationship would adversely affect pedagogical principles of justice and equal opportunities, subvert pedagogical professionalism, and risk the pupils' eroticization. Eros should only stand for the teacher's professional enthusiasm and commitment. In the 1960s and 1970s, pedagogic journals reintroduced the topic following the psychoanalytical theory and refused resistance against and tabooing of physicality, eroticism, and sexuality in educational situations. Emotions should not be suppressed, but controlled in a responsible manner because otherwise the longing for love would change into aggression and perversion. How to deal consciously with the individual and emotional experience remains vague due to the uncertainty regarding the concept of pedagogic Eros and its particularity as well as the unconsidered discrepancy in the wishes of educators and pupils.

(2) Amazingly enough, guidebooks hardly cover the problem. Pedagogic Eros is dealt with under headwords, such as "teacher's personality" or "favorite pupil." In accordance with the liberal arts' pedagogy, the authors require teachers to subordinate their emotions to the overall pedagogical concern or to transfer them to all pupils. Thus, the exclusiveness of a sensual educational relationship is supposed to be revoked in favor of teaching which serves the whole class and will be experienced in a positive way. It is remarkable that rather the elitist nature of such a relationship than the danger of sexual abuse seems to require the "emotional conversion" of teachers.

(3) The analysis of the topic in fiction books and films opens an insight into the emotional

world of sensual pedagogical relationships and illuminates how protagonists deal with norms, taboos, and conflicts. Most of them were published during the heyday of pedagogic Eros (1900–1930), when the educator "inspired" by Eros stood out among his colleagues. Emotional receptiveness and competency as well as sensitive contact to the pupils render them charismatic but also outsiders and failed personalities. The (successful or failed) use of pedagogic Eros was said to pose a threat and demands on the professional role of teachers, influencing, at the same time, their personality as well as leaving indelible marks on the pupils.

(4) Due to the particular characteristics and tabooing of the topic, it is difficult to grasp its reality in the sources. We only find single examples of particular cases, for example, in some letters from Eduard Spranger. A more promising corpus of sources is the archive of the Odenwaldschule containing letters from male and female pupils to Paul Geheeb, the founder of this reform school. Geheeb, who, in contrast to Gustav Wyneken, was not an advocate of pedagogic Eros, seems to have established a deeply emotional relationship to some of his pupils. Many addressed him in an impassioned, affectionate, and loving way, with personal confessions and questions concerning the meaning of life.

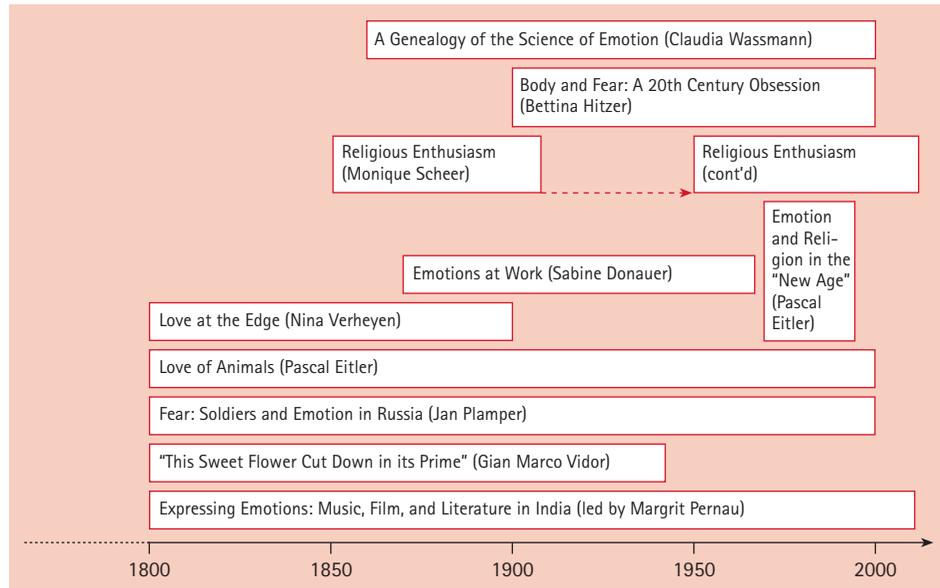
Researcher
Franziska Timm



Figure 21. Herta Thiele and Dorothea Wieck in the film "Mädchen in Uniform" (1931)

Source. Deutsche Film-Gesellschaft.

Research Area: Emotion and the Body



The language of the body—especially facial expressions and gestures—is of particular significance when it comes to identifying and deciphering emotions. This language has a biological-physiological substrate, but is very much characterized by social conventions and cultural knowledge formations. How people understand the relationship between body and soul, whether they speak of the heart and mind or of motor programs and their cortical representations, influences the manner in which emotions are felt and expressed. It bears an impact on body practices that evoke or temper emotions. The projects analyze such practices and the relevant background knowledge within various religious, aesthetic, medical, and military contexts.

Project led by Margrit Pernau

Expressing Emotions: Music, Film, and Literature in India

At present, this project is being covered by visiting researchers who work in close collaboration not only with the India group but also with European researchers investigating similar topics.

Dr. Shweta Sachdeva (Delhi University) was awarded a Max Planck Junior Research Fellowship in 2009 for her project "Historicizing Pleasure in Musical Cultures in Early Nineteenth- and Twentieth-Century India." In this project, she aims to study the relationship between music and emotions linked to pleasure, love, and sexuality, following up her PhD dissertation on the history of "Courtesans, Nautch Girls, and Celebrity Entertainers in India 1720–1920." Engaging with the wide-ranging arena of popular music, her current project aims to interpret how people defined and understood pleasurable emotions

after the early 19th century. What were the emotions that accompanied the production of music for performers? Which emotions were allowed and which were prohibited? What did the audience feel when they listened to music? Dr. Sachdeva worked at the Institute as a visiting researcher from June 1 until 30, 2010.

Professor Sunil Sharma (Boston University) is a specialist on Persian literature in the Indian subcontinent. He has published a number of studies on the *shahr ashob*, a genre which laments the destruction of a city and which contains a detailed description of the city's inhabitants, classified according to their professions and class. During his stay at the Institute, from May 1 until 31, 2010, Professor Sharma worked on a Persian text from the early 19th century, the *Tashrih ul Aqwām* written by Col. James Skinner, which forms an interesting link between the older descriptions and the

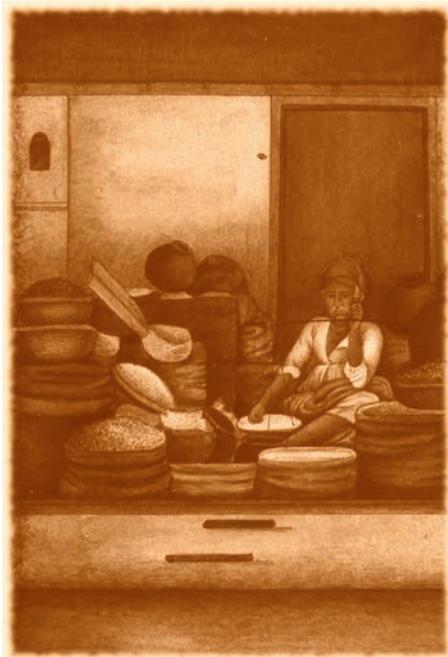
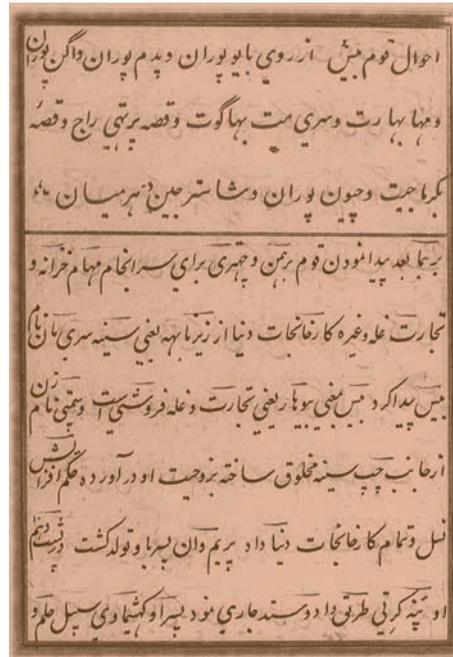


Figure 22. Persian manuscript Tashrīh ul Aqwām.

Source. Col. James Skinner (1824), Tashrīh ul Aqwām.



colonial gazettes which became common in the 19th century. Professor Rochona Majumdar (University of Chicago), who visited the Institute from June 15 until July 10, 2009, is working on the project "Art, Politics and Mass Affect in a Forgotten Era: Indian Cinema 1931–45." The project focuses on the introduction of the "talkies" in India, which turned cinema, more than ever before, into an object of mass consumption. To succeed as a mass commodity, films not only needed to develop a mass aesthetic but also to relate to the rhetoric, emotions, and passions through which the nationalist movement was bringing into existence a political and social entity called "the masses"; until the present day, in India, films are one of the most important media binding the nation into an emotional community. Professor Choudhri Mohammed Naim (University of Chicago) is one of the most distinguished scholars of Urdu literature. He has recently started a project examining the use of the concepts of *tahzib* and *tamaddun*, both roughly to be translated as civility, in Urdu literature. During his stay at the Institute, from November 1 until 20, 2011, he focused on a

new aspect: While civility is usually thought to conform to rules laid down in religious law and ethical manuals, his research focused on attempts to overcome this conformity to the extent of turning nonconformity and the fostering of individuality into an essential aspect of civilized behavior.



Figure 23. Group meeting with Professor Choudhri Mohammed Naim.

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Love of Animals: On the Emotionalizing of Human-Animal Relationships in the 19th and 20th Centuries

Nowadays, especially in most Western European and North American societies, it is taken for granted that animals have emotions. At least "higher" animals, so we are taught, can feel love and joy or pain and fear, and, because of this reason, these animals are considered worth to be protected against cruelty. This project explores the ambivalent history of how this emotionalizing of human-animal relationships developed during the 19th and 20th centuries. Moving from the individual to the social sphere, this phenomenon has attracted high public interest with important consequences on large numbers of animals and humans. In this context, the project focuses on the dynamic developments in Germany between ca. 1850 and ca. 2000 in comparison with the (to some degree much better researched) developments in Great Britain, the United States, and France. The goal is to historicize this phenomenon and to place it within a social context, posing questions concerning the changing cultural

conditions and political ramifications of the love of animals. In this manner, the project tries to prevent a scientifically unproductive moralizing of human-animal relationships. What is much more important is that particular people had to first attribute particular emotions to particular animals, which could be disputed by other people.

As a first step, the aim was to show why the history of human-animal relationships is important for the history of emotions. It has been shown how manifold changing differentiations between humans and animals were involved in the common knowledge about emotions, in the life sciences as much as in popular encyclopaedias or within the animal welfare movement that emerged between the mid- and the late 19th century. The idea that animals have emotions became the basis for further reflections about human emotions and their "origins" within the animal body. Against this background, the project reconstructs the manner in which emotionalizing human-animal relationships worked differently in three fields which mostly shaped this process from the 19th to the 20th century: the field of vivisections and laboratory animals, the field of family and family animals, and the field of presenting or representing animals in the zoological garden or the zoological museum. Meanwhile, the research on the love of animals, with the focus on laboratory animals, is almost complete.

Especially as far as family and family animals are concerned, we know very little about how and for which reasons people, in the first line children, have learned to differentiate between "pests" and "pets," animals to fear or to take care of, animals to kill, and animals to love. Which specific emotions did children have to feel and to display and for which animals? The first studies show clearly that pedagogical advice literature and children's books allow for a fascinating reconstruction of this part of the emotionalizing process: During the second half of the 19th century, this process also moved increasingly from the private sphere into the public arena.

On this question, as well as on other ones, this project treads on groundbreaking scientific territory considering the gaps in the current



Figure 24. "What have I done to deserve this?" Compassion: The "most human" emotion?

Source. Bund gegen den Missbrauch der Tiere, around 1950.

state of research. What has been available until now is a wide range of philosophical interpretations, but hardly any empirical research on the emotionalizing of human-animal relationships from a historical perspective, combining different groups of sources, such as periodicals of the animal-protection movement, advice literature, scientific compendiums, and conversation lexicons, as well as selected newspapers, novels, pictures, and films.

Emotion and Religion in the "New Age" (West Germany 1970–1990)

Sociologists and historians of religion very often assume that the experience of strong emotions is constitutive for religions and religious experiences per se. Against this background, especially the so-called "New Age" of the 1970s and 1980s is normally perceived as a very emotional religious community or discourse. In fact, the role of emotions within the "New Age" was much bigger than it was within the more well-established Christian churches of this time.

This project tries to show that the link between religion and emotion is not a quasi natural but a historical phenomenon. Before religious emotions can be felt and taken for granted, so the hypothesis, they have to be produced, learned, and incorporated under very different cultural conditions and in many different ways. In this context, the aim is to point out the important role of the history of the body for the history of the emotions. The "New Age" is a very suitable topic to highlight this correlation because most of its devotees were quite aware of the fact that the desired emotions had to be trained and observed for a long time. They thought and they taught that this emotionalizing of religion and the "self" is hard work, hard work on the emotional "self," which very often needs the help and advice of a special teacher, over weekend seminars, or on the compulsory "trip" to Asia: emotions needed experiences. Especially men, who had been taught—as one influential master narrative suggests—for hundreds of years not to show or "live" their feelings, were expected to elaborate on their emotional states, to talk about and to share

their pain and fear. This was the context for hundreds of male "self-help groups" which emerged in the 1970s and 1980s. In this context, this emotionalizing of religion was deeply embedded within the gender struggle after "1968." The so-called "new man" of this time was first and last an emotional man. Thus, this project gives a major account of the strategies and techniques—the techniques of the body—through which people were trying to produce and to enhance emotions within themselves or within other devotees of the "New Age," for example, in the case of meditation methods, yoga, so-called "biofeedback therapies" or new concepts and practices of group experiences. Here, the "New Age" played an important role for the development of a therapeutic movement which constructed and promoted "real" and "deep" feelings as collective and shared feelings. With a focus on the dynamic developments in West Germany during the 1970s and 1980s, the project contextualizes these strategies and techniques within the "alternative milieu" after 1968. Against this background, the project can show that emotions in the "New Age" had not only a religious but also a political dimension. For the "alternative milieu," it was very typical not to differentiate between politics and religion because the goal was to form an emotional "self" beyond such traditional dichotomies. In this frame, combining different groups of sources, such as advice literature, esoteric magazines, political pamphlets, and scientific commentaries, as well as selected newspapers, novels, and films, the project tries to give a new perspective on emotionalizing processes in West German contemporary history, an area which has not yet been thoroughly investigated.

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Figure 25. Shared feelings: Group therapy within the "New Age."

Source. The New-Age Journal "Esotera," 1970th.

Researcher
Bettina Hitzer

Key Reference

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Figure 26. Poster, Anti-Cancer Campaign.

Source. Touring exhibition "Fighting Cancer," around 1931.

Body and Fear: A 20th-Century Obsession

Who is not afraid of diseases? Fear of diseases seems to be something quite natural, not subject to historical change. But the way in which fear of diseases has, or could be told, judged, managed or used has changed dramatically over time. Focusing on cancer and aging, the research project investigates the relationship between feelings and notions of fear, bodily practices, health politics, health insurance, and medical as well as pharmaceutical research from roughly the 1920s to the late 1980s. The focus is on Germany, taking transnational discussions and cooperations into account. The research draws on a broad range of sources, such as selected newspapers, autobiographies, novels, films, exhibitions, public health and medical periodicals, as well as archive material from health authorities and insurance and pharmaceutical companies.

The project explores three main aspects:

- (1) How and when would people talk of cancer and aging? What notions of fear, if at all, were related and could be discerned?
- (2) How could one explain these changing patterns of "fear talk"? What part has

to be assigned to altered notions of the self and the body, to the ever-increasing significance of the idea of prevention, to shifting medical, psychological, and social assessments of anxiety?

- (3) How did these shifting notions of fear affect decision making in politics, medicine, and the economy?

The results to date testify to the enormous complexity and ambiguity of fear-related cycles closely intertwined with questions of responsibility, blame, and meaning. This seems to be especially true when it comes to cancer. A short outline may illustrate some aspects of the far more detailed findings: Since the beginning of the 20th century, first early detection campaigns discussed the crucial importance of a kind of balanced "cancer anxiety" for persuading people to constantly check their bodies. During the 1930s, detection efforts were intensified, but body-related anxiety was judged very differently. By portraying a machine-like body, national socialist health campaigns tried to de-emotionalize cancer detection and to counterbalance anxieties by offering easily accessible detection procedures. Still, they tried to exploit fears related to the responsibility (of parents) and liability to the "Volksgemeinschaft." In the 1950s, the negative assessment of cancer fears was sharpened to the point of inventing a "cancer psychosis." Thus, media and doctors alike agreed more or less upon keeping silent about cancer as a way of counteracting a much feared cancer psychosis. In the late 1950s, severe criticism was voiced leading to a complete de-pathologizing of cancer fears. In the wake of a larger reevaluation of anxiety itself as well as a popularization of psychosomatic ideas, the corporeal aspects of cancer were increasingly replaced by a trend to depict cancer as a kind of emotional experience. The fear of getting cancer was, at this point, classified as a kind of healthy reaction to a "sick" environment and way of life, and, therefore, used as a tool for political action.

Somewhat different trends seem to be valid for conceptualizing and experiencing the process of aging which will be examined at the next stage of the research.



Figure 27. Poster, Anti-Cancer Campaign.

Source. Hamburg Association for fighting and researching cancer, around 1975.

Fear: Soldiers and Emotion in Russia, 1800–2000

Using the example of Russia, the project first asks how soldiers were conditioned to cope with their fear, second how they did deal with their fear, and third how they themselves were treated when they could no longer cope and broke down with fear-induced symptoms. To this end, it employs a wide range of sources—from templates for the sermons of military priests to officer handbooks for the training of recruits, to military psychiatry and memoirs. While it looks back to 1812 and forward to the Chechen Wars, its focus is on the early 20th century, especially the Russo-Japanese and First World Wars.

The third question regarding soldiers who broke down with fear-induced symptoms has been the center of attention so far. A prize-winning coauthored article explores the comparative place of fear in French, German, and Russian medical theories of military “trauma” during the First World War. In these three countries, at least half a million soldiers were diagnosed with trauma—*émotion de la guerre, Kriegsneurose, travmaticheskii nevroz*. Fear played a key role in these disease constructs and the therapies used to cure them. Specifically, the article looks at pathogenesis (the importance accorded to fear in the descriptions of the origins of mental illness), masculinity (the relationship between fear and concepts of manhood), and spatiality (how soldierly fear correlated with specific places, such as the trenches or the home front). One of its conclusions is that the professional identity of the military psychiatric profession and its relationship to the state were critical factors in determining a national

military psychiatry’s conception of soldierly fear. French military psychiatrists were united by a strong esprit de corps and a belief in Republicanism and were thus less likely to attribute the causes of war-related mental illness to genetic or social predisposition, as, for example, in the concept of the lower-class “degenerate.” German psychiatrists were close to the Wilhelmine state and, hence, in a radical turn from previous scientific dogma in 1916, began emphasizing predisposition rather than the horrors of the war itself as the trigger for the disease—which absolved the Kaiserreich from paying veteran pensions to traumatized soldiers. Russian psychiatrists, by contrast, strongly identified with the peasant soldiers, whom they considered as lacking in political participation as they themselves. Nowhere was the gap between the state—embodied in the Tsarist autocracy—and the military psychiatric profession greater than in Russia and nowhere was psychiatric empathy for shell-shocked soldiers greater than in Russia.

A detailed research on fear in Russian military psychology showed how, for example, Tolstoy’s 1855 *Sevastopol Sketches* helped widen the boundaries of what could be written about soldierly fear and how General Dragomirov’s (Russia’s leading military theorist) writings during the 1870s and 1880s, already centered around the soldier’s fearful “psyche.” If at first military psychologists had conceptualized soldierly fear as a mere symptom, over the last decades of the 19th century, they began viewing it as a pathogen, causing a variety of diseases, including “male hysteria” and “traumatic neurosis.” The Russo-Japanese War produced more than 6,000 cases of traumatized soldiers, and the 1905 Revolution engendered even more fear talk—fear of social upheaval and chaos. As for the image of human nature that lay at the bottom of the etiology of fear-induced mental diseases, there were, in essence, two options: Either fear was a component of human nature or fear was unnatural. In 1911, an article identified two “doctrines” regarding soldierly fear—a “romantic” and a “realistic doctrine.” The former saw fear as an aberration from the norm of brave soldiers, while the latter assumed that all soldiers experience fear.

Researcher
Jan Plamper

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Figure 28. Russian trauma patients, World War I.

Source. L. M. Pussep, *Travmaticheskii nevroz voennogo vremeni* (Petrograd, 1918), p. 79.

Researcher

Monique Scheer

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Religious Enthusiasm: Emotional Practices Among Revivalist Protestant Groups in the United States and Germany

The project on religious enthusiasm since the 19th century analyzes the relation between emotional norms and religious experience among those who cultivate highly emotional practices as well as those who are critical of them. The study combines anthropological and historical approaches. Fieldwork among charismatic Christians—known for the intensity of their emotional practices—and among mainline Protestants includes participant observation and narrative interviews focused on how Christians talk about emotions in relation to their religious practice. This information is situated in broader historical contexts through the examination of sources which discuss the same issues in the 19th century, including polemics against revivalist groups, apologetic writings defending the cultivation of intense emotional states in church, and first-person accounts that discuss religious experience in terms of emotions. Enthusiastic Protestantism in Germany in the past 150 years has been closely intertwined with that of the United States and England. This transnational network also plays into debates about emotional styles between different religious communities, and it remains visible today in charismatic churches.

One of the primary aims of this project is to theorize more fully the concept of emotional practices. Rather than viewing religious feelings as something “triggered” by religious practices, such as singing a hymn, murmuring a prayer, or listening to a sermon, it seeks to interpret empirical material based on the

idea that emotional styles are learned and practiced as a “technique of the body” (M. Mauss). Thus, the presentation of the results is organized around bodily practices and comportment rules in collective worship, the hearing and making of music and private communications with God. It also explores the role of language in shaping emotional experience.

The approach based on the notion that emotions are learned and cultivated, their expression practiced, at times “merely performed” and at others experienced as involuntary and spontaneous, conceptually unites cognitive and bodily knowledge, bridging the gap between discourse and experience. This approach emphasizes that cognitive and physical components of emotions are inextricably intertwined, that learning to name a feeling and learning to have it cannot be neatly separated. Thus, a study of emotions in religious practices must take discourses about emotions into account if it wants to understand what people are experiencing and why. Throughout this period, debates between “enthusiasts” and “anti-enthusiasts” are also debates about the status of emotions – where they come from and what they mean. It is important to understand these Protestant theories of the self and emotions because, among other reasons, they are deeply entangled with those developed in academic psychology in this period.

Beginning with the hypothesis that emotionalized Christian practice is based on the notion that emotion itself is a form of communication with the divine, it has become clear in the course of the study that this notion varies depending on how the self is theorized in a given system of thought. Mainline Protestants and charismatic Christians appear to have many more attitudes about emotions in common than originally hypothesized; it is in the bodily accomplishment of such shared values as “sincerity” that they differ.

The examination of the shifting currency of discourses and practices in different Protestant groups from the nineteenth century to the present day aims to historicize religious experience and to contribute to a broader history of emotional practices in Europe.



Figure 29. Jesus Culture youth conference in Redding, CA.

© www.flickr.com, ChasingFuries, 28.7.2006

Love at the Edge: Fatherly Feelings in 19th-Century Ego Documents

Autobiographies are a common source for 19th-century European history. Very often written by middle-class males, autobiographies were a peculiar genre with specific rules regarding their content and style. Looking back upon a life spanning several decades, subjects reported in a loose chronological order the ideal rites of passage for the dynamic, modern Western masculine life: growing up, getting educated, finding a job, starting a family, achieving economic success and public recognition, slowing down and sitting down to write.

Authors insisted on telling the "truth and not fiction," as Franz Lorinser, a theologian in Breslau, wrote in his memoir published in 1892. From the perspective of cultural history, though, the border between fictional and autobiographical writing was more blurred. Along narrative rules and social norms, middle-class males *constructed*, rather than documented, a meaningful life and a valuable self—a trait also applied to their description of emotions, often constructed *through*, rather than depicted in autobiographical texts. Seen more as a social practice than a mirror of real life, ego documents like autobiographies and letters or diaries, are therefore key to the history of emotions.

Against this background, the research project asked how German-speaking middle-class males constructed fatherhood and especially fatherly feelings in 19th-century ego documents. Was paternal love a topic at all? Did the topic change its shape and function through time? Where autobiographies are concerned, being a subtype of ego document aimed more specifically at

public audiences, paternal love was rarely mentioned. Still, the topic never vanished completely—certainly not around 1800, when the German middle classes longed for tender forms of masculinity and fatherhood; and neither ca. 1900, an era whose harsh and seemingly emotionless absent or distant fathers have often been described. However, there is evidence that paternal love as a topic of autobiographical writing substantially changed its form and function throughout the 19th century. If fatherly feelings were touched around 1800, they were often presented as a regular element of the masculine middle-class self. For example, episodes of paternal love were closely intertwined with descriptions of professional life. When at all mentioned 100 years later, paternal love was more often presented as an unusual experience that allowed the author to leave—and complement—the regular realm of his life for a brief moment. Fatherly feelings were still an important part of masculine identity, but pointing at its edge rather than its center.

Researcher

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Figure 30. The tax inspector Alfred Ludwig Fröhnert with his son, Vienna 1907.

Source. Bestandsverzeichnis Sammlung Frauennachlässe. Zusammengestellt von Li Gerhalter, Institut für Geschichte an der Universität Wien, 2008, p. 207.

**"This Sweet Flower Cut Down in its Prime."
Emotions in the 19th- and 20th-Century
Italian Cemeteries: The Case of Children's
Graves**

During the second half of the 19th century, two slow and interrelated processes started to affect the lives of predominantly upper-class children in urban Italian society: The transformation of the demographic conditions marked by a drop in child mortality rates and changes in cultural perceptions regarding children. Care, love, protection, control, education, and health became increasingly important for the upbringing of the offspring in aristocratic and bourgeois families. All these changes in children's lives, in which adults increasingly invested both emotionally and materially, were certain to have a deep impact in the way parents experienced and coped with the death of a child. Modern Italian cemeteries, that is, those established outside the city walls since the beginning of the 19th century, have preserved fragments that can shed light on these distressing events and the response they triggered. The way in which the space was arranged in cemeteries, the family graves, or the individual funerary monuments all bear traces revealing how upper-class parents dealt with the loss of a child. The project focuses on the impact that the age of the deceased child, the cultural and socioeconomic status of the family, the religious beliefs, and the cause of death, bore on the emotional dimension of this experience, the way the bereaved families



Figure 31. Cemetery of Lucca: Monument Giuseppino Salani, 1885.

© Gian Marco Vidor

dealt with it, as well as the opportunities and manner of expressing the feelings triggered by the death.

The study of the 19th- and 20th-century funerary culture linked to the loss of a child in a European country is still a historiographical *terra incognita*, especially seen from the perspective of the history of emotions.

Six urban cemeteries in central and northern Italy have been chosen: Bologna, Florence, Livorno, Lucca, Padua, and Turin. Marked by numerous and well-preserved graves, these cemeteries have been surveyed and all visible funerary monuments for children dating from the beginning of the 19th century to 1940 have been photographically documented. For practical reasons of thematic scope, the Jewish sectors have not been taken into consideration, and the non-Catholic Christian ones will be considered only from a comparative point of view. The funerary monuments are analyzed based on both their iconographical and epigraphical components with the help of a database. Close scrutiny of these elements will offer the opportunity to partially understand what kind of emotions are depicted and in which manner, how their representation changes over time, and which impact the age and sex of the child bear. It is important to underline that the mere existence of monuments or tombstones dedicated specifically to children, with their particular emotional dimensions, seems to be linked to developments regarding the mortality rates of children and young adults: In the first half of the 19th century, they are rare and they become more common as we approach the end of the century marked by lower mortality rates. It seems that developing a deep relationship with a newborn or a young child was related to the child's chances of survival.

In order to access the past emotions inscribed on these numerous built and written artefacts, work with archival primary sources on the funerary culture concerning children and mourning parents is indispensable. Which ritual and spiritual guidelines and advice did the Catholic Church provide to families coping with the death of a child? Why is the figure of the Virgin Mary as *Mater Dolorosa*, archetype of the mother who lost a child and so popular in the Italian religious "landscape," absent in funerary monuments for children? What was the role of the cemetery in the bereavement of the parents? To what extent can the 19th-century necropolis be considered as a particular "emotional space"? These are some of the main questions on which the 2-year postdoctoral project will focus.

A Genealogy of the Science of Emotion, 1860–2000

At the turn of the 21st century, the emotions have become one of the most vibrant fields of research in various disciplines. But what do we mean when we speak of "emotion"? From where does our language of emotion come? The research project zooms in on the grounding moment of our contemporary emotion terms: scientific psychology in the second half of the 19th century in central Europe. At that moment, lengthy treatises classified the emotions from a Spiritualist point of view. However some young aspiring scientists thought that the Spiritualists' take on the emotions was no longer satisfying. A natural scientific concept of emotion was needed and it was developed, at first on theoretical grounds. Experimental research was to follow only decades later.

The project traces the genealogy of our contemporary emotions terminology back to three contexts: in the mid-19th-century German physiological literature, its reception and transformation in French psychological writings, and the debate about "the nature of emotion" that revolved around William James' *Principles of Psychology* (1890). The implications of the reconfiguration of emotion in these three contexts are huge and reverberate throughout the entire 20th century, from experimental psychology, to the most recent research in neurosciences, the "emotional turn" in humanities, and the larger sociocultural everyday usage of the language of emotion. The project inquires into the origin and nature of emotion as an epistemic object both in academic psychology and in physiological research. It asks what kind of ascriptions about the emotions were made by scientists, that is, with regard to emotion and rationality, psychopathology, gender, race, children's emotions, and methods to study the emotions. How did scientific claims change over time? How did this affect our vernacular concepts of emotion and vice versa?

Research is being carried out on three levels:

- Firstly, on the level of scientific theory a top-down approach is favored allowing for primary sources to be considered. The focus is on the content of scientific theorizing

about emotion particularly in German and French sources that have received little attention so far.

- Secondly, the experimental practices deployed in the study of the emotions in psychology, pedagogy, and psychiatry are being analyzed within a comparative socio-cultural frame.
 - Thirdly, the traffic of emotion terms between science and the vernacular is analyzed from a transnational perspective.
- In a first part, this project has shown that emotions were given a crucial role in a new understanding of the brain function. However, in the process of the debate regarding the nature of emotion that took place during the 1890s, emotions became an unsolvable riddle to psychological research. Alfred G. Lehmann's gold medal winning monograph of 1892 on the main laws of human emotional life, marked a shortlived consensus. Behaviorism soon declared that emotions were useless and mere luxuries as far as their biological function for the organism was concerned. Yet, at the same time the emotions were securely anchored in the brain, thus becoming a prerogative of medical research. In psychology, the focus of research shifted to the social and the performative realms.

In a nutshell: This project examines how concepts of the emotions have shifted in disparate cultural realms, including psychology, medicine, and pedagogy since the mid-19th century, and considers theories, practices, and the vernacular that have shaped our contemporary understanding of the emotions. Sources are monographs, textbooks, and scientific journals in physiology and psychology as well as manuals on the emotions addressed to lay audiences in Germany, France, and the United States.

Researcher

Claudia Wassmann

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Figure 32. Etching illustrating the physiognomy of the passions.

Source. Smith, R. (1997). *The Norton history of the human sciences*, plate 8. New York: W. W. Norton. Source of the image indicated in the book is the Wellcome Institute Library, London.

Researcher
Sabine Donauer

The PhD project supervised by Ute Frevert and integrated in the Center's research program is part of the Cluster of Excellence "Languages of Emotion" (Free University Berlin).

Emotions at Work—Working on Emotions, Germany 1870–1970

At the center of this project is the following observation: Within the process of industrialization, increased attention was given to the emotions of those who worked on large-scale production sites (*industrielle Erwerbsarbeit*). From the end of the 19th century onwards, new questions were being asked by social reformers, social scientists, physicians, and psychologists: Are workers satisfied with their work environment? Do they distrust their immediate supervisors? Do they feel their work is boring or do they even harbor disgust when it comes to highly partialized work on the assembly line? To what extent does their emotional engagement influence their "working curve"? How could "human relations" be improved to create a happy worker and a more productive work environment? Such questions were mainly triggered by two factors. First, strikes and social unrest posed a severe threat to a smoothly running economy. The danger of an outbreak of workers' resentment and "class hatred" would manifest itself with work stoppages and high levels of absenteeism. Second, especially scientists started to argue that production levels could be increased if companies managed to give their workers the feeling of being valued and supported.

This project assesses the role of science as crucial for both charging emotions in the workplace with new and powerful meanings and offering knowledge on how to deal with them. The emergence of entirely new

scientific fields revolved around how people behaved and felt at work: Occupational science (*Arbeitswissenschaft*), industrial and organizational psychology (*Arbeitspsychologie*), and industrial sociology (*Betriebssoziologie*) figure most prominently here. Furthermore, subdisciplines were developed within business studies, such as human resources management (*Personalwesen*). Against this backdrop, the following question sets are at the center of the project:

- (1) How do emotions become a research subject in the above named disciplines? How does the scientific interest in emotions relate to contemporary nonscientific (political, social) debates and issues in society?
- (2) How have these scientific fields conceptualized emotions over time? How should emotions be worked on according to their findings, that is, should they be controlled, counterbalanced, or dealt with in therapeutic talk?
- (3) Which media and agents translated scientific knowledge on emotions into industrial practices? Which training programs were used in companies to change emotional behavior?
- (4) How did the scientifically produced knowledge on emotions affect the perception, evaluation, and the expression of emotions in the workplace?

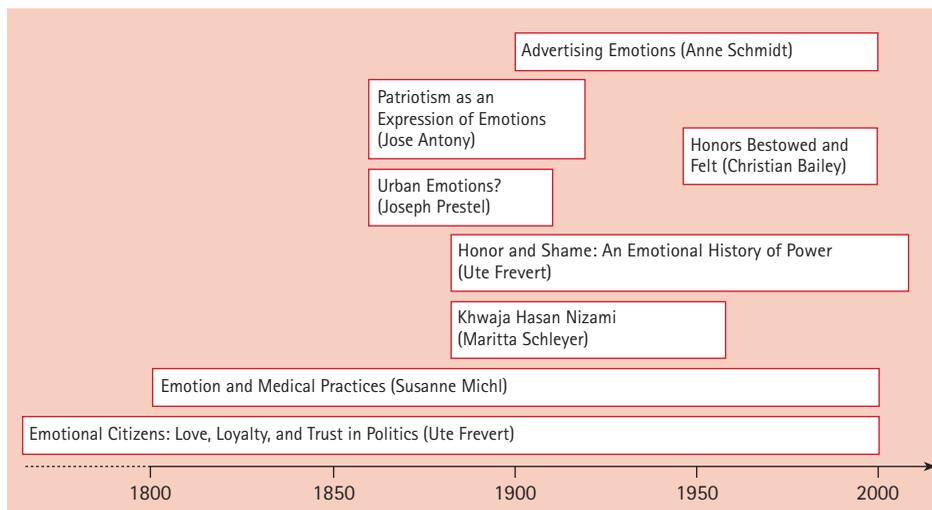
These questions will be answered by looking at a variety of sources, such as academic publications, companies' training manuals on interpersonal skills, popular scientific advice literature for employers and employees, as well as material from corporate archives. The project is based on the guiding hypothesis that the perception of, and dealing with, emotions in the workplace underwent a process of scientification (*Verwissenschaftlichung*) in the course of the 20th century. One effect of this process is that the working self became deeply psychologized, with the inner life perceived as an economic resource—the "human factor." This development carried with it an array of historically specific "technologies of the self" (Foucault) changing the emotional makeup of employers and employees alike.



Figure 33. Training workshop for machine fitters.

© Siemens Archive (SAA 8543; 1933)

Research Area: Emotion and Power



The power of feelings is often invoked, but rarely examined in more detail. Furthermore, little do we know regarding the ways in which feelings are modeled by power structures and used by those in power. The projects with this research focus explore such interrelations and processes in topics from the fields of politics and business. Central emotional concepts of national and international policy (such as honor and disgrace/shame, or loyalty and trust) are investigated as well as the manner in which the carefully controlled and observed importance of feelings unfolded in the world of consumerism and advertising.

Honor and Shame: An Emotional History of Power

Honor is back on the agenda. American protest movements campaign for "restoring honor" to a nation doomed to a seemingly dishonorable fate. The French President accuses the European Commission of "hurting the national emotions" by criticizing the French policy of deporting foreign citizens—another word for insulting the French honor. Migrants in Europe coming from North African and Middle Eastern cultural backgrounds force family members to defend their family honor and sanction those who allegedly have violated it. Instances like these testify to the relevance of a research project that focuses on honor and shame during the long 20th century. Both are emotional concepts closely tied to premodern societies. According to Max Weber, the rise of capitalism and bureaucratic administration poses a critical challenge to practices and relations based on honor and shame. Economic interest rather than estate-bound notions of

honorable behavior seems to govern the modern world both on the national and international level and in personal relationships. The project seeks to test and refute Weber's hypothesis by detecting and investigating practices of honor and shame in 20th-century Europe. It deliberately chooses those practices both from the realm of high politics and social behavior, suggesting that both worlds are intimately connected. Societies, so the argument goes, that do not acknowledge notions and practices of individual or family honor find it hard to come to terms with notions and practices of national honor. Research carried out in 2009 and 2010 has concentrated mainly on two aspects:

- (1) the relationship between war, national honor, and honorable conduct; and
- (2) the impact of so-called male gender characteristics on notions and practices of honor.

As to the role of war, the ways in which countries during the First and Second World War treated those citizens who had not been

Researcher
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born there but migrated to those countries later in their lives was examined. Even if they held legal citizenship, they were given a hard time, conforming to the demands of national honor and loyalty. Prejudices were strong both on the state level and in public discourse. Those prejudices were fuelled by fear as well as concepts of racial and national superiority. Practices of exclusion and shaming thus varied according to which social and ethnic groups were targeted as potential traitors and internal enemies.

Another way in which war shaped—and changed—notions and practices of honor has been studied with regard to international conflict and "critical moments" in which new world orders with new moral and emotional guidelines were perceived, projected, and realized. Modern wars during the 19th and 20th centuries had all been waged under the auspices of national honor; their outcomes, though, more often than not radically changed notions of honorable conduct. Europe, in particular, started (national as well as colonial) wars with clear ideas on who possessed honor and who had to be shamed. Still, in the aftermath of those wars, especially

in the 20th century, new world orders were established that, in the shape of an expanding human rights and dignity discourse, saw different concepts of honor emerge and develop. As to the second line of research, connections between male gender characteristics, practices of socialization and education, and notions of honor and shame have been explored. Starting from the assumption that gender plays a crucial role in how honor is defined and perceived by historical actors, the emotional topography was analyzed as it developed since the late 18th century both for men and women. Focusing mainly on heroism and military conscription, the project questioned how those discourses and institutional practices served to expand honor (a concept originally applying exclusively to noblemen) to broader strata of male society.

Emotional Citizens: Love, Loyalty, and Trust in Politics

During his first 100 days in office in 2010, Federal President Christian Wulff received thousands of letters and emails from ordinary citizens who felt the need to share with him their concerns and opinions regarding immigration, a "hot" issue in German politics and society. Apart from those, there were thousands of other letter writers who approached him on different grounds, sometimes asking for help, sometimes criticizing politics, and very often simply content with expressing their reverence and trust.

Emotional communication has become an important factor in modern politics that has been largely overlooked by political science

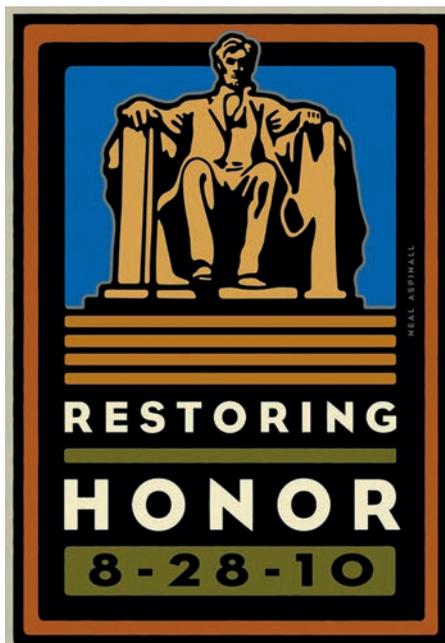


Figure 34. Logo of the "Restoring Honor Rallye," August 28, 2010, Washington DC.

© "Restoring Honor Rallye"



Figure 35. Election campaign poster promoting confidence.

© CDU <<http://www.bilder.cdu.de>>



Figure 36. People outside the palace cheering for the young king Frederick.

Source. <http://friedrich.uni-trier.de/de/kugler/117-d1/detail/> - Universität Trier, Projekt "Werke Friedrichs des Großen."

and history. Modern politics (as long as it is not totalitarian politics) is often thought of as unemotional, rational, instrumental, and strategic. The bureaucratic state, according to Max Weber, seems to be acting under transparent and generalized rules, asking its citizens to follow suit. In real life, though, traditional notions of charismatic politicians still have a lot of leverage and manifest themselves in numerous ways. In elections, politicians ask for people's trust and confidence; between elections, they present themselves as "good people" who love their spouses and children and even extend their love to the broader public.

To what degree is what might be described as the "emotionalizing of politics" a new phenomenon? How far back in history can it be traced? Is it tied to a particularly modern notion of democratic politics, and what distinguishes various types of modernity in terms of emotional communication?

These questions guiding the research project are asked on two levels: On the one hand, politics is analyzed as to its emotional content and formats. Focusing on heads of state, practices of emotional self-marketing and self-staging are examined. Going back as far as the 18th century, those practices were investigated with regard to the Prussian king Frederick the Great from 1740 to 1786. Starting from his self-concepts as they developed since adolescence, the project questioned whether and how these self-concepts were put into practice during various phases of his long life as a major European monarch. How



Figure 37. Frederick on horseback parading into the city of Breslau, saluting the masses by raising his hat.

Source. <http://friedrich.uni-trier.de/de/kugler/139-d1/detail/> - Universität Trier, Projekt "Werke Friedrichs des Großen."

did his claim to "reign over the hearts" of his subjects relate to his actual politics? How did he manage to transform the rule of fear to a rule of love that he claimed to pursue? Why, if at all, did he find it necessary to change the principles of ruling?

On the other hand, the manner in which citizens and subjects approached the king was examined. What did they expect and demand? To what degree did they accept or challenge the way power was communicated? What kind of emotions did they display toward the king and for what reasons?

Amongst the emotions communicated between prince and citizens, trust played an increasingly important role. Taken up by liberals and democrats during the 19th century, trust came to signify a quasi-symmetric relationship between those who governed and those who were governed. But how did notions of loyalty and fidelity correlate with this history of democratization? And how and why did undemocratic political regimes "highjack" notions of trust and fidelity? Both National Socialism and State Socialism in the German Democratic Republic (GDR) heavily played on the semantics of trust—to what ends? It is challenging to see how those semantics fared after those regimes broke down—were they immediately converted into a different language, were they discarded altogether, or did they survive unchanged?

These questions have been elaborated both on a more general and a more specific level in several articles, lectures, and reviews, ranging from political theory to constitutional debates.

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Researcher

Christian Bailey

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Honors Bestowed and Felt: Germany and Britain After 1945

This project analyzed the bestowing and receiving of political honors as a form of commodifying and exchanging honor in modern Germany and Britain. Throughout the modern period, honor was a quality attributed to individuals who observed certain codes of behavior and who were recognized by their peers as honorable, expressed through a variety of gestures and rituals. While individuals' sense of their honor in the eyes of others has nevertheless often been unstable and the source of emotional struggle and conflict, one of the rituals which has commodified honor as an enduring form of social capital is the bestowing and receiving of political honors.

The study researched how such a commodification of honor has been used not only to establish or reinforce hierarchies but also to reward or compensate citizens for their services to the nation and to regulate the emotional lives of those honored and their peers. Furthermore, it analyzed how the awarding of honors aroused, exacerbated, and relieved such emotions as shame, jealousy, guilt and pride, and formed part of an emotional regime maintained by modern states. It attempted a three-way comparison of honors-giving in the German Federal Republic, the German Democratic Republic, and the United Kingdom, asking whether honor remained a constant within and across these different political cultures or whether it changed in the wake of ideological ruptures and the diverse manners in which people experienced and remembered history.

The project so far has analyzed the honors system (re)introduced in the German Federal Republic. Whereas throughout the 19th and early 20th centuries honors were liberally awarded after periods of military conflict as a means of recognizing service, managing the often traumatic transition from war to peace and justifying the war effort, Germans were forbidden from rewarding military service after 1945. When honors were reintroduced, Germans initially clamored for them, while increasing numbers also sought to display honors earned during the war years, in spite



Figure 38. HRH Duke of York; Major General JNR Houghton, CBE, Lord Crathorne, Lord Lieutenant Of N Yorkshire; General FR Dannatt, CGS (RLH).

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of this being forbidden. By contrast, West German public figures, politicians, and the mass media from the 1960s onwards displayed less enthusiasm for these symbols of official recognition. In this regard, they were similar to their counterparts in the United Kingdom, however dissimilar to their fellow Germans in the German Democratic Republic, where honors-giving and political ritual continued to play a significant role in citizens' lives. Although official support for honors has increased in the reunified Germany in the last decade, the greatest appetite for honors has been shown by individuals representing groups that feel insufficiently honored and recognized: womens' groups, the now internationally active military, members of ethnic minorities, and representatives from the new *Bundesländer* in the East.

This project has been complemented by broader research into social emotions, specifically a chapter within a multi-authored volume on the conceptual history of emotions. For this, the focus was on changing conceptualizations of social emotions since the 18th century in Britain and Germany, contrasting, for instance, the consistent valorization of interpersonal emotions, such as sympathy, with an increasing pathologization of collective emotions, such as anger or excitement in crowds.

Emotion and Medical Practices: Trust in the Doctor–Patient Relationship in 19th- and 20th-Century Germany

Autonomy is one of the keywords to describe the developments in the medical systems in 20th-century modern societies, especially concerning the encounter between doctors and their patients. Nevertheless, little attention has been paid to another less individualistic and rational, and more social and emotional, phenomenon: The emergence of a highly complex and differentiated health system is based on successful strategies and mechanisms of trust, trust production, and trustworthiness. In this project, trust stands for a complex emotional management that is effective in the range of health practices by patients and doctors. How are emotions regulated, steered, encouraged, or impeded, and by whom? Which forms of emotional expression are judged as adequate or inadequate? Which emotional rules and norms are set up and how are these rules dealt with?

At two turning points in medical history, approximately in the second half of the 19th and in the first half of the 20th century, the discourse on trust was particularly intensified, and the emotional management changed considerably.

(1) The shift from a prescientific medicine to a medicine with its specialized knowledge, expensive instruments, and disease agents occurred in the second half of the 19th century. Various facets of this shift have been studied by medical historians. Still, it remains a *desideratum* to demonstrate how the discourse on the need to trust and be trusted and the conceptualization of other feelings accompanying the therapeutic encounter changed, given the emergence of a highly complex and functionally differentiated modern health system. According to the sociologist Anthony Giddens, there are two kinds of commitment in the modern world intensely connected with the need for, and development of, trust: the *facework* commitments and the *faceless* commitments. Whereas the former imply a face-to-face or personal trust between those who know one another, at the core of the latter lies a rather abstract expert system based on different mechanisms of trust. In this approach,

encounters between doctors and patients could be perceived as access points which are, according to Giddens, “sources of vulnerability for abstract systems.” The emergence of scientific medicine in the middle of the 19th century strengthened the perception that emotions disturb the doctor’s clinical gaze upon the patient’s body. Still, great efforts had to be made in order to suppress the emotions emerging during a medical encounter. The trust production, though, had to rely even more on external habits and conducts than on emotional patterns.

(2) In the 20th century, the doctor–patient relationship did not remain static. Especially since the 1920s more attention has been paid to psychological dimensions of the medical encounter. Particularly in a psychoanalytic approach, the emotions of the patient as well as the doctor were scrutinized in their interaction. The famous book “The Doctor, his Patient and the Illness” by psychoanalyst Michael Balint had an enormous impact on the conceptualization of a highly emotional doctor–patient encounter. For a successful therapy, Balint strongly emphasized the self-cultivation of the general practitioner who is required to control and dose his or her emotions, conceived as drugs, accelerating or slowing down the patient’s recovery.

Researcher

Susanne Michl

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Figure 39. Der Patient (Das Vertrauen/Trust), F. Silber.

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Researcher
Anne Schmidt

Advertising Emotions

The project explores the meaning and importance of emotions in advertising throughout the 20th century in Germany and asks in which ways emotions were a constitutive element of capitalist practices of production and consumption. In the first phase of the project, advertising theory has been of major importance. The first results can be summarized as following:

In the beginning of the century, several economists and entrepreneurs, but mainly artists and art critics, explored ideas on advertising. Emotions played an important role in those reflections, but they were not supposed to be exclusively responsible for forming people's decisions and actions. The advertising specialists' main concern was to identify the aesthetic principles through which they could touch consumers on an emotional level and attract the attention of the busy city-dwellers. The Kaffee HAG company utilized these concepts exemplarily by paying high attention to a modern corporate design, artistic advertising and packaging, stylish points-of-sale, fashionable coffee shops, and attractive sales representatives.

During the interwar period, psychologists discovered advertising as a crucial domain. Affects and instincts became more important than aesthetic values. A striking shift occurred as consumers were viewed as mainly irrational, easy to manipulate, and with their emotionality much stronger than their logic. The most important change during the 1930s was that the focus shifted from a product-

oriented to a consumer-oriented perspective. As a consequence, conceptualizing and observing target groups became more important. Observing affects and instincts was gradually replaced by an awareness of the important role of consumer desires, hopes, and needs.

After the Second World War, marketing theories were more than ever adapted from the United States. Theories influenced by psychoanalysis and behavioristic approaches were in vogue. Advertising was regarded by many as omnipotent. The idea of managing a business by taking the consumers' needs into account, crucial for American entrepreneurs for decades, became more important. During the 1960s, advertising experts became increasingly doubtful regarding the influence potential of advertising. Empirical research and various advertising "flops" showed that consumers were relatively resistant to advertising messages. Complex theoretical approaches on communication became important and attributed more autonomy and rationality to consumers.

Since the 1980s, marketing experts have redirected their focus on emotions and moods. Through the emotional turn in cognitive psychology, emotions are no longer viewed as the opposite of cognition. Emotions are regarded as motives in decision-making processes. The neuroscientific turn in the 1990s pushed this emotional turn in advertising further. Since the turn of the millennium, a large number of books on neuromarketing has been published. Numerous authors promise completely new insights into consumers' emotions and their suggestibility. But there are also critical voices warning against this hype, highlighting that this new knowledge only proves what is already well known.

The next phase of the project will analyze the concepts of consumers and their emotions in more detail. Against the backdrop of advertising know-how, it will concentrate on several case studies in order to establish whether and how this know-how was put into practice. Finally, contexts and practices of reception will be examined to identify the ways in which advertising attempted to affect consumers' emotional lives.



Figure 40. Riefel Porzellan, 1907.

Source. Kraft Foods Deutschland (Ed.). (2006). *100 Jahre Kaffee HAG: Die Geschichte einer Marke* (p. 203). Bremen: Edition Temmen.

Patriotism as an Expression of Emotions Among the Gujarati-Speaking Hindu Mercantile Communities in Ahmadabad, Surat, and Bombay, 1858–1922

The Great Upheaval of 1857 in North India is considered a landmark in the development of patriotism which led to the liberation of India from the colonial rule in 1947. In 1858, however, the colonial rule was strengthened with the Proclamation of the Queen. This introduced a new theory of rule for colonial India which provides a starting point for historians studying emotions linked to the emergence of patriotism and seeking to demonstrate that emotions had the power to make and/or change history in colonial India.

The research project will investigate the role emotions played in the emergence of patriotism among the Gujarati-speaking mercantile communities in Surat, Ahmadabad, and Bombay in West India. The emotions at the focus of my research are shame, honor, trust, loyalty, resentment, and guilt among patriots of merchant communities, which occurred as a consequence of the relationship between those communities and the colonial rule. The time-line of the project spans from 1858 up to the noncooperation movement of 1920–1922 (a political event of national importance which redefined patriotism in the early 20th century) led by Mohandas Karamchand Gandhi, a prominent leader of the Gujarati-speaking merchant communities from Western India.

The project critically views the mercantile patriotic tradition in order to investigate how the merchant communities, which historically had fostered a relationship of trust and loyalty with the rulers, adapted their emotionality over a period of 64 years. The research questions how this patriotic tradition failed to sufficiently address and denounce the following colonial interests: (1) commercial, (2) internal security, and (3) the legitimacy lent to the ideology of the civilizing mission. To what extent was this limitation of the patriotism emerging from the mercantile classes owing to the overlapping interests of commerce and the need for internal security in order to ensure that trade could be conducted undisturbed? Which factors contributed to

important groups of merchants acquiescing to colonial rule and adopting the civilizing mission ideology? The project addresses these issues through the lens of the history of emotions which can offer insights into the reasons for the failure of patriots by studying the overlapping emotionality binding common colonial and mercantile interests.

Ritual and symbolic incorporation of prominent members of the mercantile communities into the Imperial system from 1858 to 1880 and its liberal institutions from 1880 to 1915 assume importance in the study of emotions and emotion-related changes which fostered the rise of the patriotic tradition in the urban centers. By 1922, a unitary notion of Indian patriotism emerged with enforced severe repercussions in the way it altered perceptions and redefined standards and norms for a patriotic behavior in the entire British India. During this later phase, the socioeconomic institutions of merchants, called the *Mahajans* (roughly equivalent to “the chamber of commerce” or “guilds”), assumed importance in the anticolonial movement owing to their traditional institutional role of social and economic control. The older traditions were transformed into the mass political movements to reassert the social authority these social segments (indigenous mercantile order) traditionally held in the larger society.

It is essential for the initial stages of the research to examine a broad range of source materials in state archives of the urban centers in Western India, including municipal and judicial records. Supplementary sources—literary genres in Gujarati, novels, poetry, and essay collections—offer insights into the 19th century notions of patriotism.

Researcher
Jose Antony



Figure 41. Drawing from the 1920s. In the center, a Gujarati trader from Bombay.

Source. Battye, E., *Costumes and Characters of the British Raj*. New Delhi, 1982.

Researcher
Joseph Ben Prestel

Urban Emotions? Debates on the City and Emotions in Berlin and Cairo (1860–1914)

Big-city dwellers are characterized by their urban surroundings even in their most mundane habits. This assumption informs a wide array of scientific inquiries into the life of big-city dwellers today. Between criminologists who analyze urban fear, sociologists who examine the erotic behavior of people in big cities, or anthropologists who shed light upon the emotional implications of gated communities, scholars seem to believe that the urban realm has an important impact on emotions. Are “urban emotions” therefore an essential consequence of life in the big city? Is there a history of urban emotions?

This project seeks to analyze the role emotions played in a phase of intensive urban change in two cities. It will trace debates regarding the city and emotions as well as shifts in emotional practices in Berlin and Cairo between 1860 and 1914. Did contemporary observers identify particular urban emotions? If so, which actors used the concept of urban emotions? Did debates about emotions influence urban change in Berlin and Cairo? As a way of providing answers to these questions, the project will utilize three case studies for each city. Firstly, the observations of contemporary scholars on shifts in patterns of feeling in Berlin and Cairo will be examined. Authors like Hans Ostwald or Muhammad Al-Muwaylihi commented widely on the impact of urban change on big-city dwellers in their respective city. To provide a historical context

beyond these scholarly debates, the second case study will focus on changes in the way emotions were policed during this period. It will examine the manner in which the law-enforcing agencies dealt with particular emotional practices, like processions, festivities, or erotic encounters in public. Thereby, it will trace shifts in the institutional handling of emotions in Berlin and Cairo during the second half of the 19th century. Finally, the third case study will provide analytical underpinnings concerning the impact the concept of urban emotions bore on urban change in the two cities. In particular, the ideas of the Garden City Movement regarding the psychological implications for the inhabitants of big cities proved influential in the building of suburbs in Berlin and Cairo after 1900. Ultimately, the Garden City Movement sheds light on the transnational dimension of urban emotions. Having originated in England at the end of the 19th century, its ideas about the need for reform in big cities became influential in various countries. To which degree such a shared perception of urban space was tied to a shared understanding of emotions in the big city will be one of the central questions addressed in the project.



Figure 42. Emad El-Din Street, Moustafa Kamel Pasha Square 1911.

Source. Serageldin, I., Azab, K. M., El-Sayeh, S. (2009). *The photographic memory of Cairo*. Alexandria, Egypt: Bibliotheca Alexandrina.



Figure 43. Unter den Linden, corner Friedrichstraße, 1898 (photographer W. Tietzenthaler).

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Khwaja Hasan Nizami: Emotions for the Nation, the Muslim Community, and the Sufi Shrine

Khwaja Hasan Nizami (1878–1955) was a Sufi of the Chishti Islamic mystic order—an emotionally expressive devotional practice by tradition. Besides, he was an influential and controversial figure in the public life of Delhi and colonial India in the first half of the 20th century. He made himself a name as a religious teacher, reformer, and missionary. In addition, he was a highly prolific Urdu journalist and author of books and pamphlets on historical, religious, and political themes.

The research project is designed as a biographical case study of Khwaja Hasan Nizami's work from the perspective of the history of emotions. It assumes that the focus on emotions provides crucial insights into constructions of meaning by historical actors. Hence, it is a useful tool for writing a contextualized biography as it is envisaged here. By analyzing Nizami's construction of the Sufi, the Muslim, and the Indian national community in his numerous writings, the study examines the role of emotions in processes of collective identity formation. This is achieved through allotting different sets of feelings to those processes as their main identifiers. Besides, the project aims to shed light on particular ways in which leading figures of devotional Islam responded to the challenges of the changing political and religious landscape in early 20th-century India and fashioned a space for themselves in society.

The conceptualization of the dissertation has been completed. Most of the relevant primary sources, the major part of which consists of Nizami's publications, have been collected in South Asian libraries and archives and thoroughly worked through. In July 2010, a paper was presented and a panel chaired on the history of emotions in Sufism at the *European Conference of Modern South Asian Studies* in Bonn. One article entitled "Feeling Sufi—Feeling Indian" is ready for publication. It discusses the redefinition and universalization of a particular Sufi emotional style in Khwajah Hasan Nizami's 12-volume literary work on the siege of Delhi during the 1857

great Indian uprising. On the basis of close reading and analysis of the sources, the paper argues that Hasan Nizami attributed a cluster of feelings to the larger social community, which were thitherto largely associated with theological Sufi discourse and personal spiritual practice. In this widely received text, the author suggests pride, suffering, grief, repentance, love, and compassion as markers of Indian cultural identity. Feeling Sufi becomes feeling Indian. In this context, it is the inner constitution which defines national identity and not belonging to a geographic region or a religious community. Hence, Nizami constructs his vision of the contested Indian nation through the emotions as an inclusive one and as based on individual introspection and moral reform within a Sufi world view. Nizami's envisioned Sufis would be the ideal representatives of the psychic and ethic setup of the Indian citizen. Consequently, through his politics of emotions, the author also implicitly claims a central position for the Sufis in the colonial public and a possible future Indian nation-state.

Researcher
Maritta Schleyer

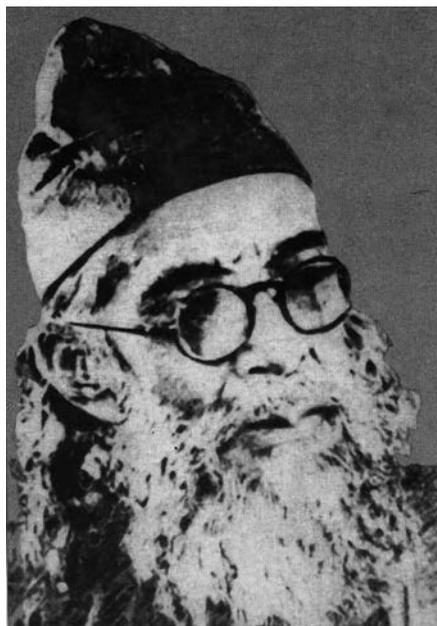


Figure 44. Khwaja Hasan Nizami, portrait as an old man.

Source. Deobandi, Majid: Khwaja Hasan Nizami. A book on the life and work of Khwaja Hasan Nizami. Anjum Book Depot: Delhi, 2007.

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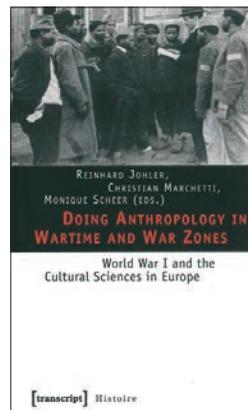
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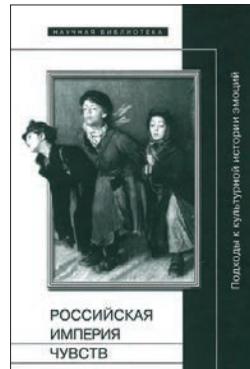
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The Center for Lifespan Psychology

The **Center for Lifespan Psychology** (Director: Ulman Lindenberger) has helped to establish lifespan psychology as a distinct conceptual approach within developmental psychology. 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 neuronal levels of analysis; and (3) to identify mechanisms of development by exploring age-graded differences in plasticity.



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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 the late Paul B. Baltes, the Center for Lifespan Psychology (LIP) at the Max Planck Institute for Human Development has helped to establish lifespan psychology as a distinct conceptual approach within developmental psychology. Since 2004, the Center has extended its research program into developmental behavioral 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 increased its research on behavioral development during earlier periods of life.

Three Guiding Propositions

The Center's research agenda can be summarized by three interrelated theoretical propositions (Lindenberger, Li, Lövdén, & Schmiedek, 2007). 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 general script for formulating research questions in more 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 attempt to arrive at more or less comprehensive theories of behavioral development. To provide explanations that qualify as psychological 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 the developing person. Hence, as John Nesselrode, Peter Molenaar, and others have emphasized, developing individuals, rather than groups of individuals or domains of functioning within individuals, form the privileged system of analysis and explanation (Nesselrode & Molenaar, 2010).

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 *senescence* denote the operation of age-graded brain mechanisms and their effects

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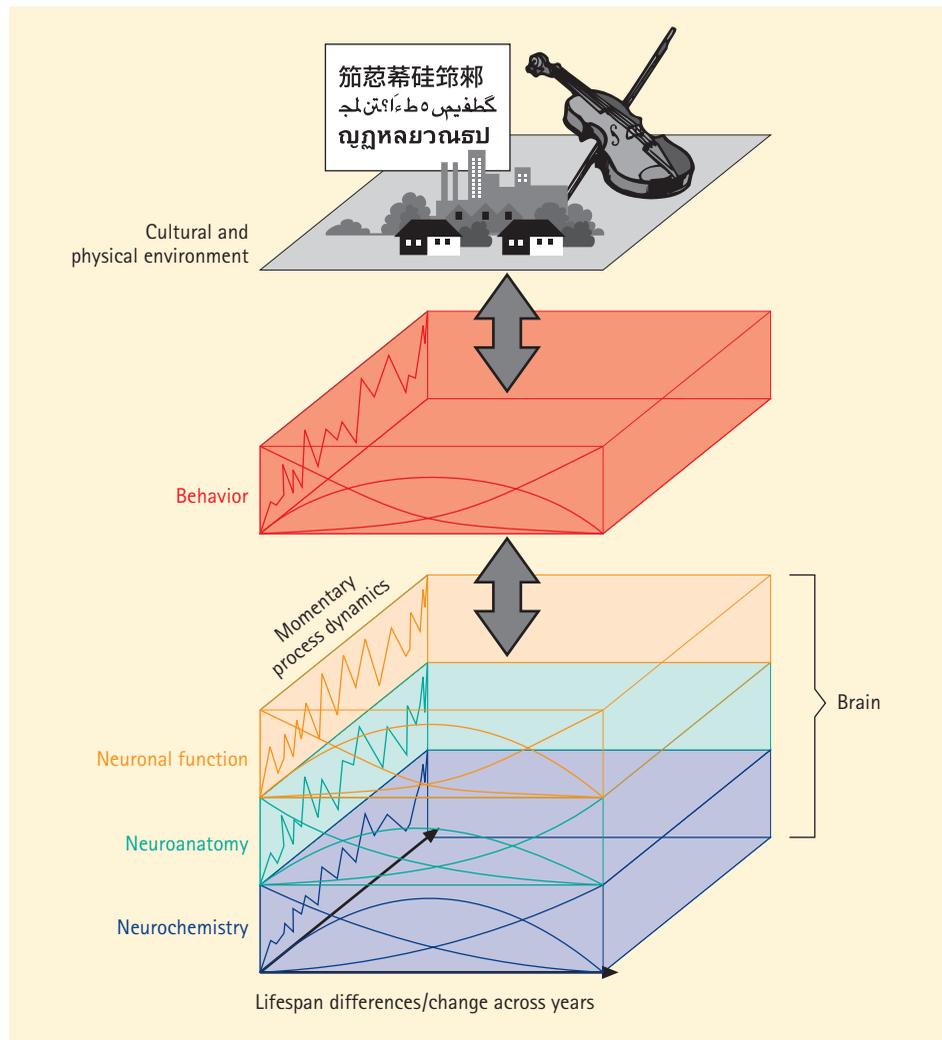


Figure 1. Environment and brain as antecedents and consequents of moment-to-moment variability and long-term changes in patterns of behavior. Lifespan changes in brain-behavior mappings are shaped by interactions among processes related to maturation, learning, and senescence. The identification of key 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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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 individuals' 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, as expressions of maturation, continue to exist in the adult and aging brain, and declines in dopaminergic neuromodulation, which indicate senescence-related changes in brain chemistry, commence in early adult-

hood. Thus, maturation, senescence, and learning mutually enrich and constrain each other throughout the lifespan and must be understood and studied as interacting forces driving the brain–behavior–environment system. In this endeavor, psychologists occupy a central position because they possess a rich and adequate repertoire of experimental and methodological tools to describe and modify the organization of behavior. From the perspective of lifespan psychology, direct comparisons between children and older adults help to identify commonalities and differences in the mechanisms that are driving child and adult development (see, e.g., Shing & Lindenberger, in press).

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

If the lifespan development of behavior is defined to originate from recursive interactions among maturation, learning, and senescence, with the developing individual as the privileged system of analysis, then 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 or of emotion regulation and motivational states. Empirically, dense multivariate time-series data are needed to assess short-term variability and long-term changes in across-domain dependencies. 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 an increase in maladaptive moment-to-moment fluctuations or a decrease in processing robustness, at both behavioral and neural levels of analysis. These maladaptive changes may signal impending long-term changes in other characteristics of the system (see Figure 2; adapted from Lövdén, Li, Shing, & Lindenberger, 2007). In contrast, other forms of moment-to-moment variability indicate an individual's ability to bring a wide variety of different strategies to the task and are positively related to long-term change in both childhood and old age.

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 (Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010). 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 the 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 (Baltes, Lindenberger, & Staudinger, 2006).

In summary, developmental psychology needs theory and methodology apt to integrate (a) multiple domains of functioning, (b) multiple timescales, and (c) multiple levels of analy-

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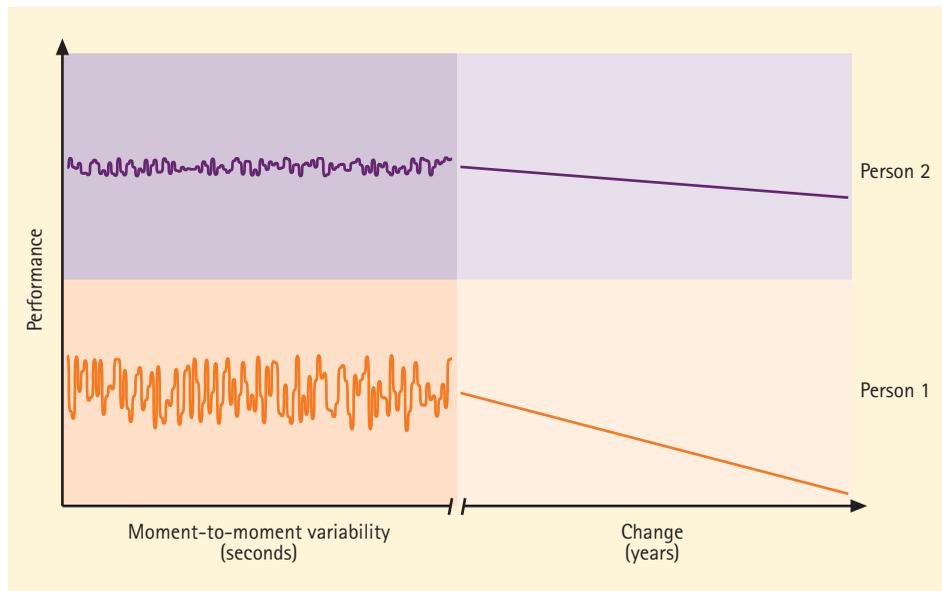


Figure 2. Example for predictions linking moment-to-moment variability to long-term change, and brain changes to behavioral changes. Senescent changes in neuromodulation lead to greater moment-to-moment fluctuations in neural signaling, enhance the prominence of background noise, reduce the distinctiveness 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. Recent empirical evidence supports this prediction (Lövdén et al., 2007; adapted from Lindenberger et al., 2006).

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sis. In recent years, the Center has relied on two methodologies that seem well suited to these conceptual demands. First, random coefficient modeling (RCM), latent growth curve modeling (LGCM), 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. Dynamic extensions of these methods, such as the dual-change score model introduced by John J. McArdle and Fumiaki Hamagami, permit the investigation of directed lead-lag hypotheses with longitudinal panel data (e.g., Lövdén et al., 2007). Second, neurocomputational modeling, such as the neurocomputational theory on the effects of age-related dopaminergic decline on behavior proposed by Shu-Chen Li and colleagues, has facilitated conceptual integration. More recently, time-delay embedding and clustering methods for time-series data as well as combinations of classifiers and structural equation modeling are being added to the repertoire (see Project 7, pp. 217–221).

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

Both from scientific and societal perspectives, behavioral plasticity, or the alteration of developmental trajectories through experience, is a precious phenomenon (Hertzog, Kramer, Wilson, & Lindenberger, 2009a). Scientifically, inquiries into the plasticity of human 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 mechanisms. In particular, cognitive intervention 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,

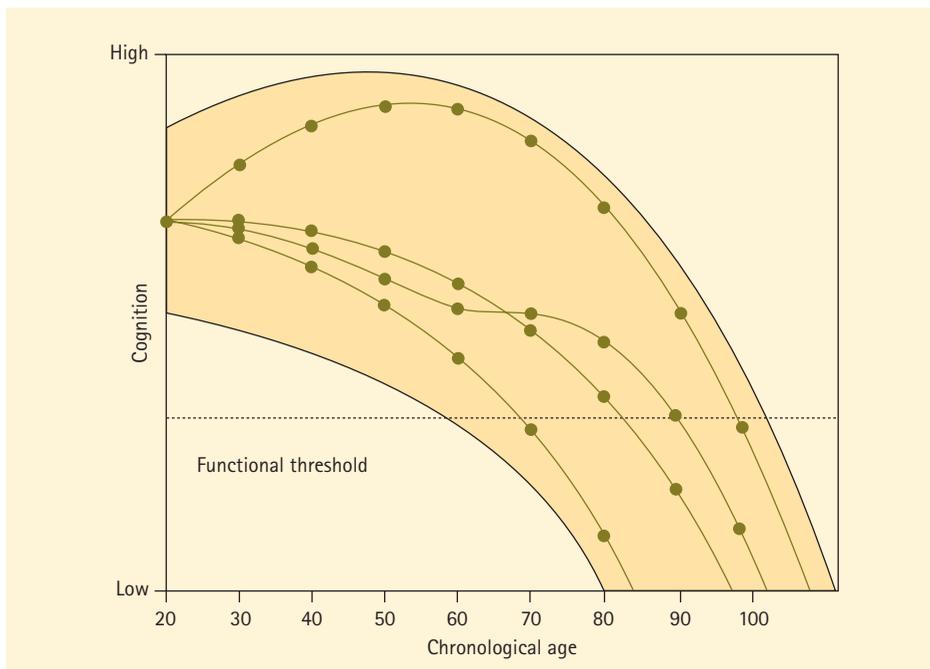


Figure 3. Hypothetical illustration of the zone of possible cognitive development for a given individual, along with four developmental curves indicating specific possible outcomes. Each possible curve starts from the same functional level at age 20, with different trajectories resulting as a function of interactions among behavioral, environmental, and genetic factors that permit movements in the vertical direction within the zone at different points in the lifespan (adapted from Hertzog et al., 2009a).

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or neurofunctional imaging measures are assessed before, during, and after training, intervention studies also offer new insights into relations between behavioral and neural levels of plasticity. Thus, by partly taking control over behavior–environment interactions, the mechanisms of learning can be studied in the context of maturation and senescence. 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 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 human development. For 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. During

the reporting period, central results of two large-scale studies, the COGITO study and the SPACE study, have been published as the result of a successful collaboration between the Sofja Kovalevskaja Research Group (Principal Investigator: Martin Lövdén; see pp. 177–182) and the Intra-Person Dynamics project (Principal Investigators: Florian Schmiedek and Martin Lövdén; see pp. 190–194). The two studies have revealed plastic changes in brain and behavior in adulthood and have helped to delineate their modulation by genetic factors and adult age (Lövdén, Bodammer et al., 2010; Lövdén, Schaefer, Noack, Bodammer et al., in press; Lövdén, Schaefer, Noack, Kanowski et al., in press; Schmiedek, Lövdén, & Lindenberger, 2010). Related conceptual work has aimed at identifying distinct features of plasticity in relation to other types of behavioral and neural variability and change (Lövdén, Bäckman et al., 2010).

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Overview of Research Projects at the Center for Lifespan Psychology

The empirical and conceptual work at the Center is currently structured into seven research projects or teams of scientific investigators (see Table 1). The activities pursued in these projects cover a wide array of research areas in human behavioral development. For instance, recent studies have addressed the following questions: (a) Does social context facilitate learning and long-term retention in infants? (b) How do individuals of different ages make use of their motor synergies while walking or pointing at a target? (c) Are individual differences in the volume of subfields of the hippocampus related to individual differences in associative memory in old age? (d) How can we simultaneously model changes in old age as a function of time since birth and time to death, and in what ways do the two change processes interact and differ from each other?

Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior

In 2006, Martin Lövdén received the Alexander von Humboldt Foundation's Sofja Kovalevskaja Award. Financed by the Federal Ministry for Education and Research, this one-million-Euro Award enables young scientists from outside Germany to fund their own research groups over a period of 4 years at a German university or nonuniversity research institution of their choice. This Research Report contains the final report on the Group's research activities (see pp. 177–182). The continuation of the group's agenda in the context of a new project, tentatively labeled "Mechanisms and Sequential Progression of Plasticity," is in planning. It will conduct training experiments with large numbers of structural MRI scans over time within research participants to closely observe the cascade of structural brain changes that express the brain's plastic potential (Dissertation Elisabeth Wenger).

Table 1
The Center for Lifespan Psychology: Overview of Research Projects

<i>Name of project</i>	<i>Research scientists and postdoctoral fellows</i>	<i>Predoctoral fellows</i>
Neuromodulation of Lifespan Cognition	Shu-Chen Li ^{**} , Lars Bäckman [°] , Hauke R. Heekeren [°] , Ulman Lindenberger; Agnieszka Zofia Burzynska [*] , Ben Eppinger [*] , Dorothea Hämmerer [*] , Irene E. Nagel ^{°*}	Goran Papenberg, Susanne Passow, Nicolas Schuck, Viola Störmer
Intra-Person Dynamics Across the Lifespan	Florian Schmiedek ^{***} , Martin Lövdén ^{***°} , Manuel Voelkle, Ulman Lindenberger; Annette Brose [*] , Nils C. Bodammer, Yee Lee Shing, Markus Werkle-Bergner	Thomas Grandy, Julia K. Wolff
Cognitive and Neuronal Dynamics of Memory Across the Lifespan (ConMem)	Yee Lee Shing ^{**} , Markus Werkle-Bergner ^{**} , Ulman Lindenberger; Roman Freunberger [*]	Yana Fandakova, Thomas Grandy, Myriam C. Sander
Sensorimotor–Cognitive Couplings	Sabine Schaefer ^{**} , Michael Schellenbach ^{**} , Julius Verrel ^{**} , Ulman Lindenberger	Dominik Jednoralski, Maïke Kleemeyer
The Berlin Aging Studies (BASE)	Ulman Lindenberger ^{**} ; Julia A. M. Delius, Shu-Chen Li, Ana Sofia Morais [*]	Julia K. Wolff
Interactive Brains, Social Minds	Franziska Kopp ^{**} , Viktor Mueller ^{**} , Ulman Lindenberger; Karen Bartling [*]	Cathleen Bache, Johanna Sängner
Formal Methods in Lifespan Psychology	Manuel Voelkle ^{**} , Timo von Oertzen ^{***°} , Ulman Lindenberger	Andreas Brandmaier
Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior	Martin Lövdén ^{***°} ; for other group members, see Box 1 on p. 177	Hannes Noack, Elisabeth Wenger

Note. The table refers to projects and project members as of January 2011; for updates, visit www.mpib-berlin.mpg.de.
^{**}principal investigator, ^{*}postdoctoral fellow, [°]researchers with primary affiliation at another institution, [°]until October 2010.

Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior in Adulthood and Old Age (Concluding Report)

Researcher

Martin Lövdén
(for collaborators,
see Box 1)

Aging-related reductions in abilities, such as working memory, reasoning, episodic memory, and spatial orientation, begin roughly around the age of 65, but different individuals perform at different levels and change at different rates. Epidemiological work suggests that individuals with a lifestyle rich in mental, physical, and social stimulation experience less cognitive decline in old age (Lövdén, Ghisletta, & Lindenberger, 2005). However, we know little about the mechanisms through which experience modulates cognitive aging. For example, we do not know whether the favorable influences of an enriched lifestyle on cognitive change come from direct effects of mental stimulation on cognitive performance or through indirect routes, such as avoidance of negative effects on cognition (e. g., depression, stress, or vascular conditions). The goal of the Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior in Adulthood and Old Age was to fill this research lacuna (see Box 2).

The group defines plasticity as the capacity for reactive change in brain structure caused by a mismatch between functional supply and experienced environmental demands and resulting in an alteration of the possible range of functioning (Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010).

We further postulate that the possible range of functioning can be altered either by the acquisition of new knowledge or by the alteration of the efficiency of neural processing. If experiencing an extended period of supply-demand mismatch (see Figure 4) were shown to improve the efficiency of neural processes

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Studies Conducted as a Part of the Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior in Adulthood and Old Age

SPACE

The study investigated the practice-related changes of spatial navigation performance and underlying brain structures in younger and older adults.

Researchers: Martin Lövdén; Nils C. Bodammer, Ulman Lindenberger, Sabine Schaefer

Predoctoral Fellow: Hannes Noack

Collaborators: Lars Bäckman (Karolinska Institute, Stockholm), Emrah Düzel (University of Magdeburg), Simone Kühn (University of Ghent)

COGITO

In collaboration with the Intra-Person Dynamics project, this microlongitudinal study investigated variability and practice-related changes of intelligence and relations to underlying brain structure and function in younger and older adults (for more information on the COGITO study, see Project 2, pp. 190–194).

Researchers: Florian Schmiedek, Martin Lövdén; Markus Werkle-Bergner, Nils C. Bodammer, Ulman Lindenberger

Postdoctoral Fellow: Annette Brose

Predoctoral Fellows: Julia K. Wolff, Thomas Grandy

Collaborators: Emrah Düzel (University of Magdeburg), Simone Kühn (University of Ghent), Naftali Raz (Wayne State University)

Swedish Military School of Interpreters

Conscript interpreters in the Swedish military learn a new language from scratch to native-like proficiency within a year. Our studies of these conscripts investigated behavioral and brain changes induced by language acquisition. A new series of studies will be conducted in collaboration with Project 3 (see pp. 195–200).

Researchers: Martin Lövdén, Nils C. Bodammer

Predoctoral Fellows: Johan Mårtensson (Lund University)

Collaborators: Mikael Johansson (Lund University), Magnus Lindgren (Lund University), Lars Nyberg (Umeå University)

Box 1.

The Sofja Kovalevskaja Award

In 2006, Martin Lövdén received the Sofja Kovalevskaja Award of the Alexander von Humboldt Foundation. Financed by the Federal Ministry for Education and Research, the one-million-Euro Award enables young scientists from outside Germany to finance their own research groups at a German university or nonuniversity research institution. The funding period of the Award extended over 4 years, from 2007 to the end of 2010.

Box 2.

supporting important cognitive functions, then the hypothesis that an enriched lifestyle may positively influence adult cognitive development would be supported. Hence, cognitive interventions with training regimes that target specific brain regions and circuits hypothesized to support specific skills are a powerful tool to explore the mechanisms and amount of plasticity in adulthood.

Questions central to the Group's research agenda included: Can cognitive practice in adulthood and old age improve performance on unpracticed cognitive tasks measuring the same or different cognitive processes as the trained tasks? Which are the cognitive mechanisms and brain correlates of such performance alterations? Does experience in

the form of cognitive practice alter the brain's white- and gray-matter structure in adulthood and old age? What are the biological mechanisms of such structural changes? Which environmental, cognitive, and genetic factors determine the nature and magnitude of plastic alterations of brain and behavior in adulthood and old age? We addressed these questions in three studies (see Box 1).

The SPACE Study

In the SPACE study, we investigated changes in behavior and brain induced by spatial navigation training. The main research questions were: (a) whether structural alterations in the human hippocampus occur in response to navigation practice in younger adulthood

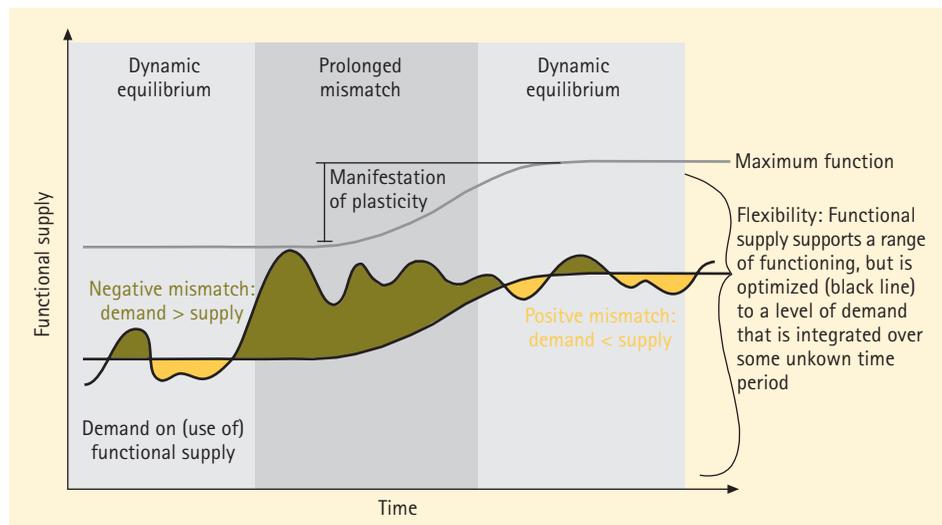


Figure 4. Schematic model of a mismatch between functional supply and experienced environmental demands caused by primary changes in demand (e.g., altered experience through cognitive training). Functional supply (i.e., the structural constraints imposed by the brain on function and performance) allows for 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, and 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 et al., 2010).

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and old age, (b) whether the magnitude of these experience-induced structural changes is reduced in old age, and (c) whether genetic influences on activity-dependent release of Brain-Derived Neurotrophic Factor (BDNF) moderate these effects. To this end, younger and older adults stratified on a common genetic polymorphism of the BDNF gene practiced spatial navigation in a virtual zoo while walking on a treadmill (see Figure 5). The practice period included 42 one-hour sessions administered every other day over a period of about 3.5 months. Control groups walked on a treadmill for a comparable amount of time. Immediately before, immediately after, and 3 months after termination of practice, cognitive performance was assessed during two sessions, and participants underwent magnetic resonance imaging (MRI), diffusion tensor imaging (DTI), and magnetic resonance spectroscopy (MRS). First results (Lövdén, Schaefer, Noack, Bodammer et al., in press) show that both younger and older adults performing the demanding spatial navigation task display

navigation-related gains in performance and stable hippocampal volumes that were further maintained for 4 months after termination of training (see Figure 6a). In contrast, control groups displayed volume decrements consistent with longitudinal estimates of age-related decline. Hippocampal barrier density, as indicated by mean diffusivity estimated from DTI, showed a quadratic shape of increased density after training, followed by a return to baseline in the right hippocampus, but declined in the control groups and in the left hippocampus. These results thus indicate that sustained experiential demands on spatial ability protect hippocampal integrity from age-related decline. The results also provide the first longitudinal evidence indicating that spatial navigation experience modifies hippocampal volumes in humans, and confirm epidemiological results suggesting that mental experience may have direct effects on neural integrity. Further detailed analyses of the younger adults (Lövdén, Schaefer, Noack, Kanowski et al., in press) addressed the neural mecha-

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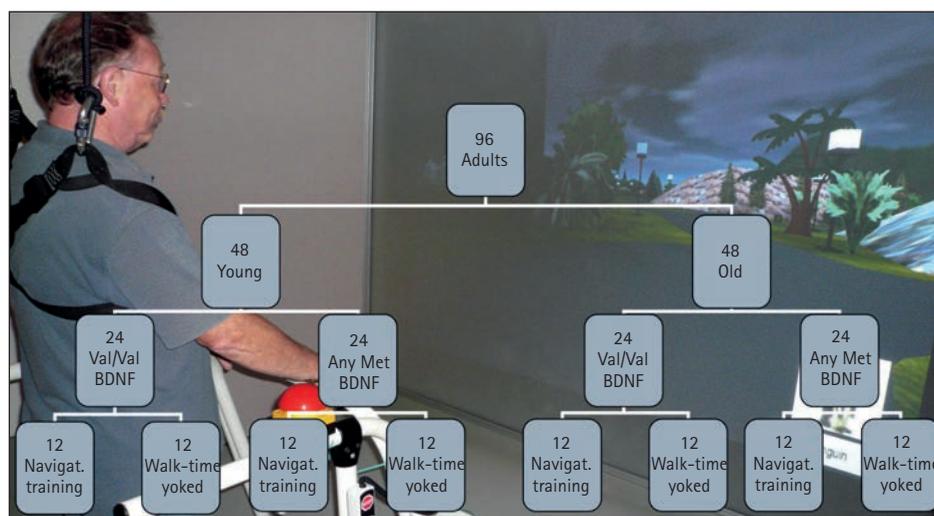


Figure 5. Design of the SPACE study. Younger and older adults stratified on a common genetic polymorphism of the BDNF gene (known to influence brain plasticity) practiced spatial navigation in a virtual zoo while walking on a treadmill. The practice period included 42 one-hour sessions administered every other day over a period of about 3.5 months. Control groups walked on a treadmill for a comparable amount of time. Immediately before, after, and 3 months after termination of practice, cognitive performance was assessed during two sessions and participants underwent MRI, DTI, and MRS. Main research questions were: (a) whether structural alterations in the human hippocampus occur in response to navigation practice, (b) whether the magnitude of these experience-induced structural changes is reduced in old age, and (c) whether genetic influences on activity-dependent release of BDNF moderate these effects.

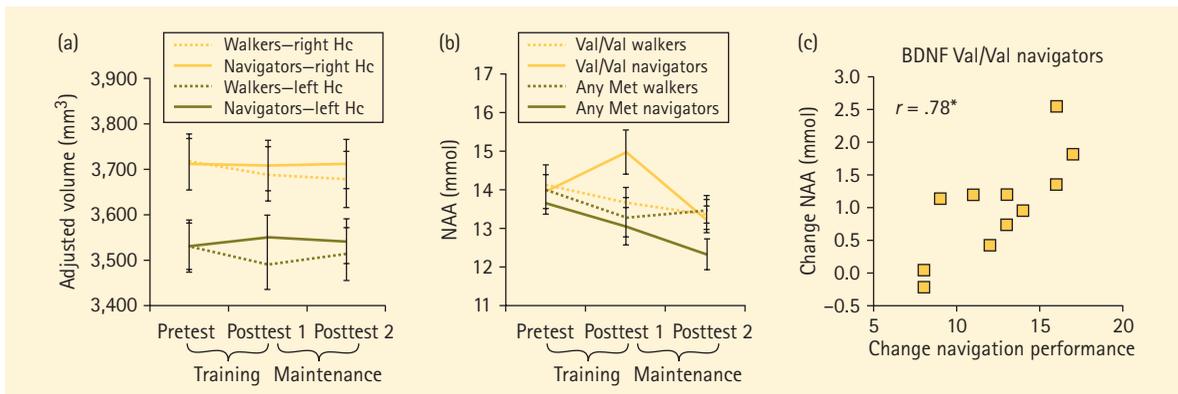


Figure 6. Spatial navigation training protects hippocampal integrity from age-related decline, confirming epidemiological results suggesting that mental experience may have direct effects on neural integrity. BDNF genotype moderates these plastic changes, which is in line with the contention that gene–context interactions shape the ontogeny of complex phenotypes and which suggests that activity-dependent release of BDNF is an important neural mechanism of plasticity. (a) Both younger and older adults performing the demanding spatial navigation task showed stable hippocampal volumes that were further maintained for 4 months after termination of training. (b) Training-induced changes in hippocampal NAA were substantial for younger BDNF Val homozygotes, but absent in carriers of the Met substitution in the BDNF gene, which is known to reduce activity-dependent secretion of BDNF. Unlike measures of brain volume, changes in NAA are sensitive to metabolic and functional aspects of neural and glia tissue and unlikely to reflect changes in microvasculature. (c) Among BDNF Val homozygotes, increases in NAA were strongly related to the degree of practice-related improvement in navigation performance. * $p < .05$ (adapted from Lövdén, Schaefer, Noack, Kanowski et al., in press).

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nisms and histological nature of hippocampal gray-matter changes by examining changes in hippocampal N-acetylaspartate (NAA) as measured with MRS. Unlike measures of brain volume, changes in NAA are sensitive to metabolic and functional aspects of neural and glia tissue and unlikely to reflect changes in microvasculature. Training-induced changes in hippocampal NAA were substantial for younger BDNF Val homozygotes, but absent in carriers of the Met substitution in the BDNF gene, which is known to reduce activity-dependent secretion of BDNF (Figure 6b). Among BDNF Val homozygotes, increases in NAA were strongly related to the degree of practice-related improvement in navigation performance and normalized to pretraining levels 4 months after the last training session (Figure 6c). These findings indicate that changes in demands on spatial navigation can alter hippocampal NAA concentrations, again confirming epidemiological studies suggesting that mental experience may have direct effects on neural integrity. BDNF genotype moderates these plastic changes, which is in line with the contention that gene–context interactions shape the ontogeny of complex phenotypes and which suggests that activity-

dependent release of BDNF is an important neural mechanism of plasticity.

The COGITO Study

In the COGITO study, conducted in collaboration with the Intra-Person Dynamics project, the group has examined changes in intelligence and underlying brain structure and function (for a detailed description of the COGITO study, see pp. 190–194). Here, we summarize the analyses done so far on a subgroup of participants from the main study that underwent functional and structural MRI before and after a micro-longitudinal practice phase. This phase lasted for a period of about 180 days during which younger and older adults trained for a total of 101 one-hour sessions on a set of three working memory, three episodic memory, and six perceptual speed tasks. In one study using this data set, we investigated plasticity of the white-matter tracts that connect the left and right hemisphere of the frontal lobes by using DTI and structural MRI (Lövdén, Bodammer et al., 2010). Control groups were assessed at pre- and posttest. Training affected several DTI metrics and increased the area of the anterior part of the corpus callosum. These altera-

tions were of similar magnitude in younger and older adults. The findings indicate that experience-dependent plasticity of white-matter microstructure extends into old age and that disruptions of structural inter-hemispheric connectivity in old age, which are pronounced in aging, are modifiable by experience and amenable to treatment. Again, our results confirm epidemiological results suggesting that mental experience may have direct effects on neural integrity. Further work within the context of the COGITO study have revealed associations between individual differences in functional brain activation and decision-making processes (Kühn et al., in press) and relationships between moment-to-moment and day-to-day variability in cognitive performance and regional brain volume (Lövdén et al., in prep.).

The Swedish Military School of Interpreters Study

The third line of research was conducted with conscript interpreters in the Swedish military. Here, we investigated the acquisition of a second language in adulthood and resulting functional and structural brain changes by examining conscript interpreters in the Swedish military. The conscripts learn a new language from scratch to close-to-native proficiency within a year. The high rate of improvement requires extremely intensive and effortful mental activities. During 2008, the military conscript interpreters and undergraduate students were measured on a battery of cognitive tasks in a pretest-training-posttest design (Mårtensson & Lövdén, 2011). We observed positive transfer from language training to a face-name associative-memory task, but not to measures of working memory, strategy-sensitive episodic memory, or fluid intelligence (see Figure 7). These findings provide initial evidence suggesting that associative-memory performance can be improved in early adulthood and that formal language education can have such effects. During the second half of 2009, brain structure and function before and after the conscripts' most intensive language studies have been examined with structural and functional MRI, DTI, and electroencepha-

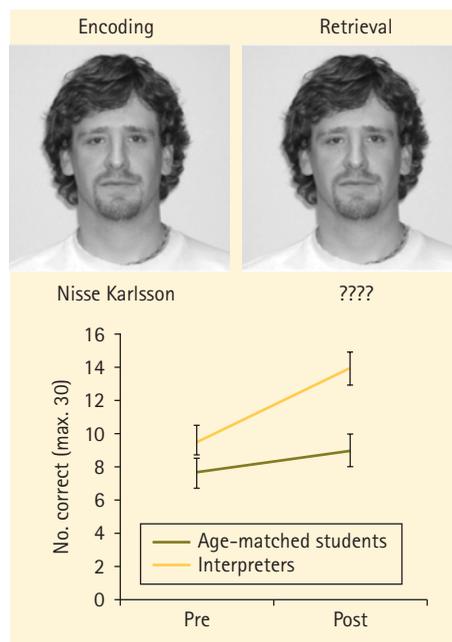


Figure 7. Conscript interpreters in the Swedish military learn a new language from scratch to close-to-native proficiency within a year. The high rate of improvement requires extremely intensive and effortful mental activities, which result in improvements in a face-name associative-memory task.

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lography. Data are currently being analyzed (spring 2011).

Summary and Outlook

The overall goal of the Sofja Kovalevskaja Research Group on the Plasticity of Brain and Behavior in Adulthood and Old Age was to further our understanding of the mechanisms through which experience modulates cognitive aging. Using the suitable interventions, such as spatial navigation training, training of intelligence, and language acquisition, as a methodological approach, the group has fulfilled its goals by providing answers to the key questions: Experience in the form of intellectual activities has direct effects on the brain's white- and gray-matter structure in adulthood and old age. These changes can be of neuronal or glial nature and are likely to be partly mediated by activity-dependent release of neurotrophic factors, such as BDNF. Our results confirm epidemiological studies suggesting that mental experience may

have direct effects on neural integrity and support the notion that staying intellectually active into old age improves the prospect for remaining intellectually fit during the later and latest stages of the adult lifespan. In the light of the group's productivity, Martin Lövdén and Ulman Lindenberger plan to pursue the agenda of the Sofja Kovalevskaja Research Group in a new project. This new

project, tentatively labeled "Mechanisms and Sequential Progression of Plasticity," will conduct training experiments with large numbers of structural MRI scans over time within research participants to closely observe the cascade of structural brain changes that express the brain's plastic potential (Dissertation Elisabeth Wenger).

Research Project 1: Neuromodulation of Lifespan Cognition

Conceptual Overview

Neurons release neurotransmitters for communication. Neurotransmitters affect the dynamics of neural networks in the course of development across the lifespan and modulate neural processing from moment to moment in the service of goal-directed behavior (Li, Lindenberger, & Bäckman, 2010a). The central goal of this project is to understand how maturational and senescent changes in neurotransmitter systems contribute to neural and behavioral development across the lifespan. The project uses an integrated array of conceptual tools and empirical paradigms, ranging from neurocomputational studies for theory development over genetically informed behavioral studies to understand the relations between neurally relevant genotypes and cognitive phenotypes, to genomic and pharmacological imaging studies for the investigation of developmental changes and individual differences in brain-behavior relations.

A major emphasis of this project is on the relation between dopaminergic neuromodulation and lifespan changes in behavior. Formal models and empirical evidence suggest that the function relating dopamine signaling to cognitive performance follows an inverted *U* (Li, Lindenberger, & Sikström, 2001; Li, Lindenberger, & Bäckman, 2010b). Hence, associations between dopamine (DA) signaling and behavior are expected to increase as dopamine signaling recedes from the apex of the function (see Figure 8). In 2008, we

generalized this prediction by formulating the "resource modulation hypothesis" (Lindenberger, Nagel, Chicherio, Li, Heekeren, & Bäckman, 2008). The hypothesis states that constant amounts of genetic variation are translated into increasingly larger performance differences as normal aging moves individuals' resources from the top to the middle portion of the resource function. The project has begun testing this hypothesis across a range of different cognition-relevant genes and cognitive functions.

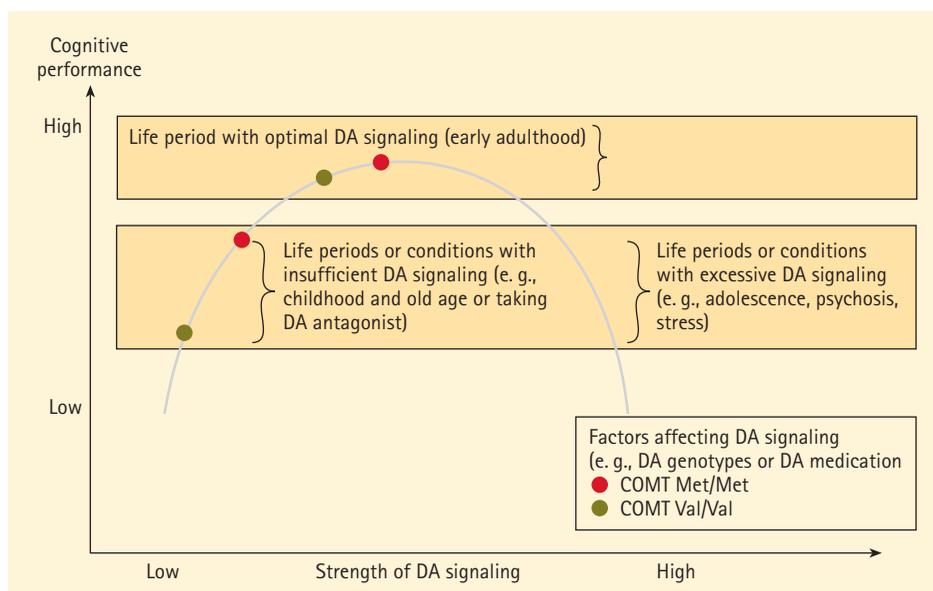


Figure 8. Lifespan age differences in dopamine modulation as well as other factors, such as genotype (e.g., COMT: gene coding for Catechol-O-Methyl Transferase), medication, stress, and psychiatric conditions that lead to insufficient or excessive DA signaling, affect the extent and patterns of dopamine effects on cognition (adapted from Li, Lindenberger, & Bäckman, 2010b).

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Empirically, the DA study, which was initiated in 2006, continues to be a core component of the project (see also Project 5, the Berlin Aging Study II [BASE-II], p. 209). Its major aims are to investigate dopaminergic neuromodulatory efficiency in relation to (a) adult age, (b) dopamine-relevant genetic polymorphisms, and (c) pharmacological intervention with a dopamine agonist. The study consists of two parts, a large-scale behavioral assessment, followed by functional magnetic resonance imaging (MRI) of working memory and executive control with and without a dopamine agonist (D-amphetamine). By January 2011, about 1,300 adults aged 20–30 years and 1,800 adults aged 60–70 years were assessed behaviorally on a wide range of cognitive functions covering working memory, episodic memory, executive control, and perceptual decision making. In addition, a total of 43 younger and 29 older adults participated in the imaging component of the study. Analyses of the imaging component are currently underway.

In the period 2009–2010, the project has examined the effects of age-graded differences in neurotransmission in three interconnected and overlapping functional domains: (1) executive control, working memory, and episodic memory; (2) goal-directed behavior; (3) attention and perception. In the following, each of these domains will be addressed in turn.

Executive Control, Working Memory, and Episodic Memory

During the reporting period, we continued to test the resource modulation hypothesis of genetic effects on cognition. In line with this hypothesis, we observed greater genetic effects on episodic memory in older adults than in younger adults in relation to genes coding for the dopamine transporter (DAT), the dopamine D2 receptor (DRD2), and the Brain-Derived Neurotrophic Factor (BDNF). Specifically, the effects of the DAT gene, the DRD2 gene, and their interactions on backward serial recall, an associatively highly demanding episodic memory task, were larger in older than in younger adults. The 10/10R genotype of the DAT gene has been found to be associ-

ated with lower striatal DA levels and reduced midbrain activation during memory encoding, whereas the CC genotype of the DRD2 gene is associated with higher striatal dopamine levels as well as more extrastriatal dopamine D2 receptors. As aging depletes brain dopamine levels, the positive effect of carrying two beneficial genotypes of dopamine-relevant genes on episodic memory appears to increase (see Figure 9a). Similarly, we also found that BDNF gene effects on behavior were only present in older adults and restricted to the associatively most demanding task conditions (see Figure 9b; Li, Chicherio et al., 2010). To further test the resource modulation hypothesis, we are currently investigating the effects of neurotransmitter genes on episodic memory forgetting, memory dedifferentiation (Dissertation Goran Papenberg), and sequence learning (Dissertation Nicolas Schuck, co-supervised by Peter Frensch, Humboldt University Berlin). In addition, we also conducted several functional and structural MRI experiments on age differences in executive control and working memory (for a summary, see Lindenberger, Burzynska, & Nagel, in press). The experiments were initially conceived as pilot studies for the pharmacogenetic imaging study (see above), but turned out to be informative in their own right. In terms of task-dependent functional activation patterns (Dissertation Irene E. Nagel), we found that high-performing older adults show load-dependent modulations of the blood-oxygen-level-dependent (BOLD) response that closely resemble the activation patterns observed in younger adults (see Figure 10a; Nagel et al., 2009). This finding was replicated and extended in a second study, which also included a psychophysical interaction analysis. Here, we found that greater load-dependent changes in the functional coupling between the left dorsolateral prefrontal cortex (DLPFC) and the left premotor cortex (PMC) were associated with better working memory performance, regardless of adult age (see Figure 10b; Nagel et al., in press). These results underscore the importance of taking performance level into account when investigating aging- and genotype-related differences in cognitive and brain functions and suggest that preservation

of a “youth-like” pattern of brain activation may help to prevent or attenuate behavioral decline in old age.

Structurally, we assessed white matter integrity and grey matter volume (Dissertation Agnieszka Zofia Burzynska). In one study restricted to young adults, we found that

fractional anisotropy, a measure of white matter integrity based on diffusion tensor imaging, in the superior longitudinal fasciculi is positively related to load-dependent BOLD responsivity in regions that are part of the working memory network and also predictive of individual differences in performance

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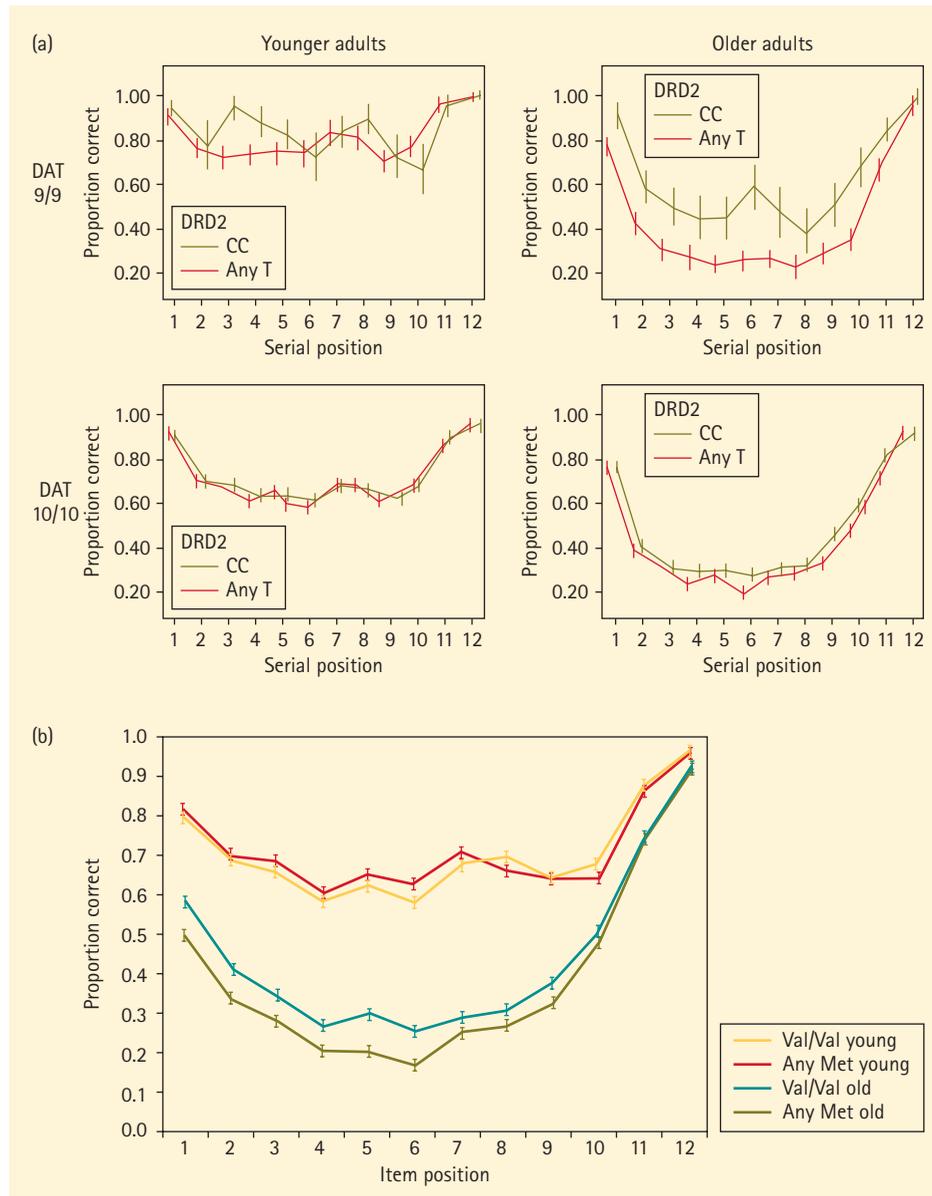


Figure 9. Examples of age magnification of genetic effects on cognition. (a) The effects of the dopamine transporter gene (DAT) and D2 receptor gene (DRD2) and their interactions were larger in older than in younger adults. (b) The effect of the BDNF gene on serial-order memory was observed only in older but not in younger adults (Li, Chicherio et al., 2010).

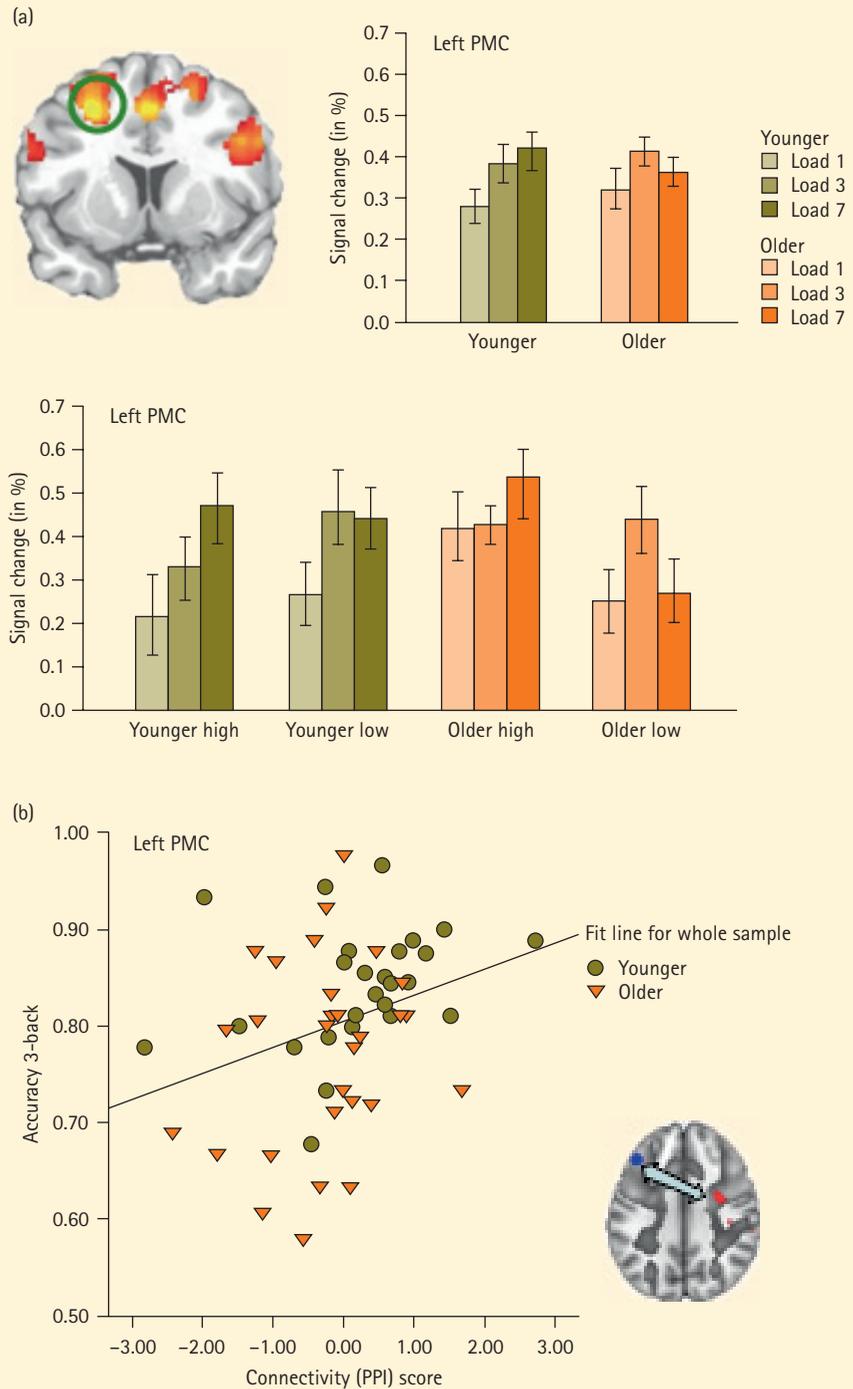


Figure 10. (a) Activations in left PMc during spatial working memory performance were modulated by task load. Performance level modulated load-dependent responsivity, with low performing older adults showing most limited load-dependent responsivity (Nagel et al., 2009). (b) Task-dependent change in coupling between left DLPFC and left PMc (z-standardized) predicts accuracy at a 3-back letter working memory task. This suggests that the coupling between left DLPFC and left PMc is important for good performance in working memory tasks in both younger and older adults (Nagel et al., in press).

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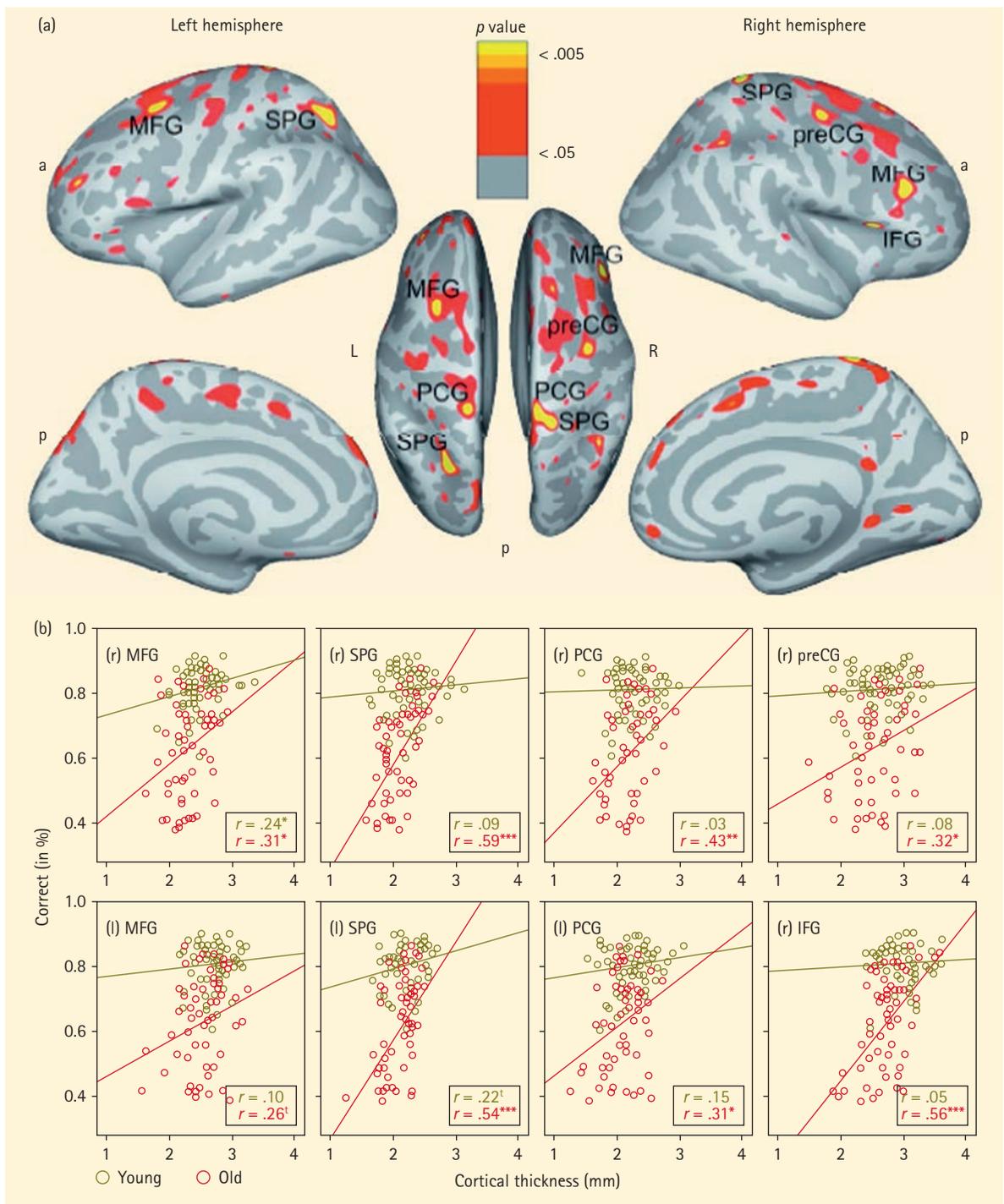


Figure 11. The relation between cortical thickness and executive control increases from early to late adulthood. (a) Areas where a thicker cortical mantle is associated with better performance on the Wisconsin Card Sorting Test (WCST), a measure of executive control in the total sample, statistically controlling for age. (b) Mean cortical thickness regressed on WCST performance. x-axis: cortical thickness in mm, y-axis: WCST accuracy (% correct); r : Pearson's correlation coefficient, * $p < .05$, ** $p < .01$, *** $p < .001$, ' $p > .05$. MFG: middle frontal gyrus; IFG: inferior frontal gyrus; SPG: superior parietal gyrus; preCG: precentral gyrus; PCG: post-central gyrus. a: anterior, p: posterior, (l): left, (r): right (adapted from Burzynska, Nagel, Preuschhof, Gluth et al., in press).

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(Burzynska, Nagel, Preuschhof, Li et al., in press). In a second study, individual differences in the thickness of the cortical mantle predicted the proportion of correct responses in the Wisconsin Card Sorting Task, a measure of executive control. Structure–performance relations were markedly more pronounced among older adults than among younger adults (see Figure 11; Burzynska, Nagel, Preuschhof, Gluth et al., in press). We are currently examining whether the observed increase in structure–performance relations with adult age is modulated by genetic differences.

Goal-Directed Behavior

Frontal and midbrain dopaminergic modulations of mechanisms of performance monitoring and reward processing play central roles in the regulation of behavior. In the period 2009–2010, we completed two studies that investigated lifespan age differences in electrophysiological correlates of response conflict and outcome monitoring (Dissertation Dorothea Hämmerer). In both cases, event-related potentials (ERPs) differed markedly between children, adolescents, younger adults, and older adults (Hämmerer, Li, Mueller, & Lindenberger, 2011). For outcome monitoring, amplitude differences between gain- and loss-related medial-frontal negativity were smaller in older adults than

in the three other groups, suggesting that older adults discriminated less well between gains and losses than children, adolescents, and younger adults (Figure 12). Currently, we are analyzing individual and age-related differences in conflict and outcome monitoring performances in relation to dopamine-relevant genotypes. Research in this field is partially funded by a cooperative research grant from the *Deutsche Forschungsgemeinschaft* (DFG FOR 778, Conflicts as Signals in Cognitive Systems) and involves collaboration with colleagues from the Humboldt University Berlin.

In the course of goal-directed behavior, individuals also take into account whether the decisions they make have immediate or delayed effects. This can be seen in tasks that require participants to choose between smaller rewards in the immediate and larger rewards in the more distant future (temporal discounting). It is assumed that dopaminergic and serotonergic transmitter systems interact in regulating such intertemporal choices. Hence, we have recently begun to investigate adult age differences in intertemporal economic decision processes and the roles of dopamine and serotonin in modulating temporal discounting (Mohr, Li, & Heekeren, 2010). Ben Eppinger and colleagues are currently piloting functional brain imaging experiments of a Markov decision task that involves three

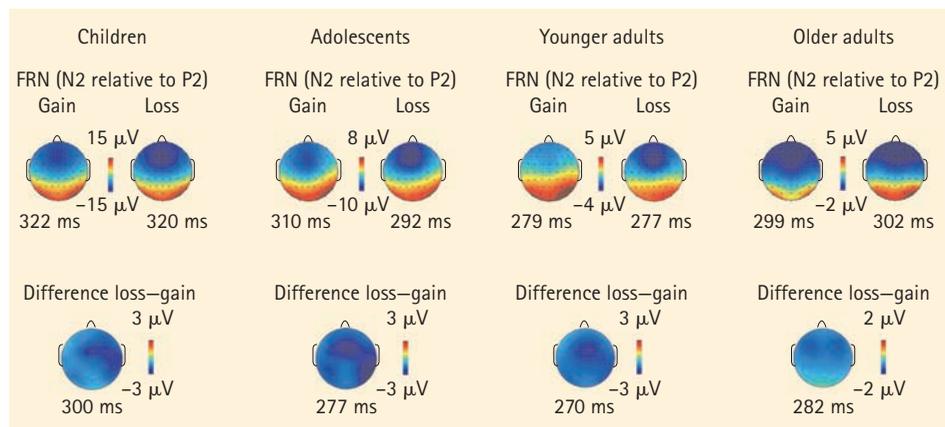


Figure 12. Scalp topographies of the stimulus-locked ERPs after gains and losses and the differences between these two types of action outcomes. The feedback-related negativity (FRN) after positive and negative differed least in older adults, suggesting that gains and losses are processed less distinctively (Hämmerer, Li, Mueller, & Lindenberger, 2010).

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reward states and a temporal discounting task to investigate the tradeoffs between short- and long-term rewards in younger and older adults. This work is partially funded in the context of a Bernstein Computational Neuroscience Network (BMBF 01GQ0913).

Perception and Attention

The efficacy of attentional regulation changes across the lifespan (Waszak, Li, & Hommel, 2010). Attention involves frontal-parietal networks that are innervated by dopaminergic and cholinergic pathways. In the third research area, we experimentally investigate age differences in perceptual and attentional mechanisms. In the domain of auditory attention, we have used an intensity-modulated dichotic-listening paradigm to manipulate both top-down attentional control and bottom-up perceptual distinctiveness (Dissertation Susanne Passow). This line of research is carried out in collaboration with colleagues from the University of Bergen (Kenneth

Hugdahl and René Westerhausen). Our findings strongly suggest that the top-down control of auditory attention is severely compromised in old age (see Figure 13a). In line with these behavioral differences, the N450, an ERP component at about 450 ms after stimulus onset, differentiated between conditions of high and low attention-perception conflict in younger but not in older adults. Similar observations were made in the visual domain (Dissertation Viola Störmer; Störmer, Li, Heekeren, & Lindenberger, 2011). In a multiple-object tracking task, ERP components reflecting attentional enhancement were larger in younger than in older adults (see Figure 13b). In future work, we will follow up on these findings in both modalities using source localization and time-frequency analyses. In addition, we are currently exploring associations between individual differences within age groups and genes influencing dopaminergic and cholinergic neuromodulation.

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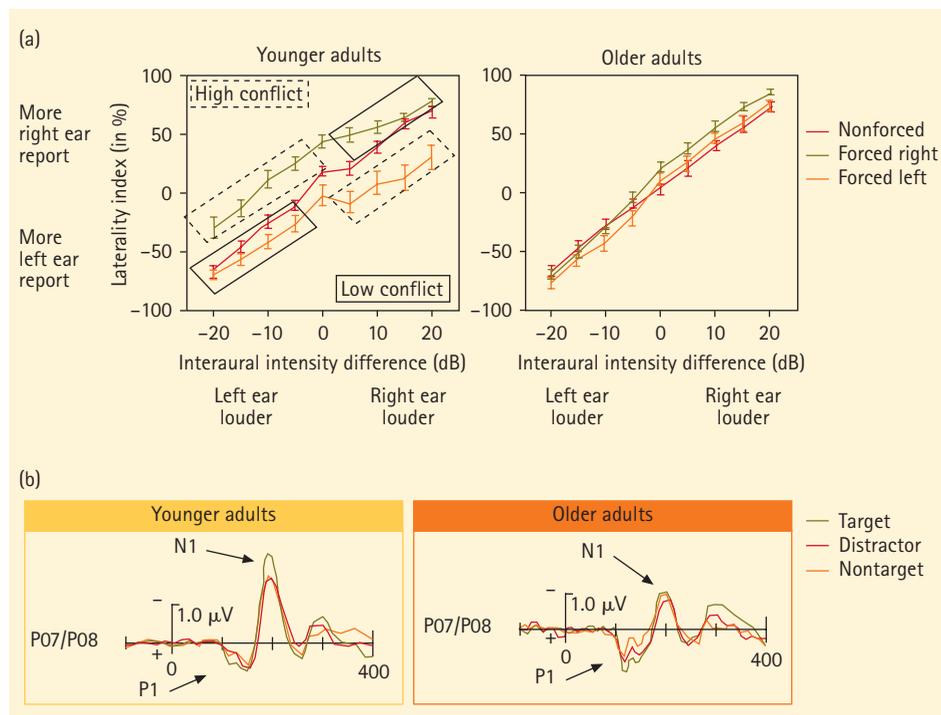


Figure 13. (a) Adult age differences in auditory attention. In a dichotic listening task, older adults were less able to regulate attentional focus and relied more on perceptual saliency (Dissertation Susanne Passow). (b) Adult age differences in visual attention for tracking multiple moving objects. Early ERP components showed a larger attention enhancement effect in younger but not in older adults (Dissertation Viola Störmer).

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Research Project 2: Intra-Person Dynamics Across the Lifespan

Intra-Person Dynamics: Forms and Functions

Behavioral development comprises both short-term variability and long-term change and is embedded in cultural, environmental, and neural contexts. The overarching objective of this project is to explore theories and research designs that articulate behavioral development across timescales, levels of analysis, and functional domains. This emphasis on empirical articulation, and conceptual integration requires a drastic increase in observation density within individuals.

When examining relations between short-term variability and long-term age changes or age differences, different forms and functions of variability can be set apart. Specifically, one may distinguish among plasticity, flexibility, adaptability, fluctuation, and temporal coupling (see Figure 14). *Plasticity*, in this context, refers to various forms of adaptive performance alterations, such as learning induced by instruction, practice, and training. *Flexibility* refers to variations in responses to environmental demands, such as the exploration of behavioral strategies during initial phases of complex skill acquisition. *Adaptability* indicates an individual's ability to regain earlier functional levels after perturbations arising from either internal processing fluctuations (e. g., attention slips) or changes in the external environment (e. g., more demanding tasks). *Processing fluctuation*, or lack of processing robustness, reflects stochastic fluctuations around a modal response. Processing fluctuations can be observed more

easily when other forms of variability are low, as is often the case for standard reaction-time tasks, or when they have been reduced, as is the case when individuals have consolidated the use of a particular strategy and are operating near maximum levels of functioning. Finally, *temporal coupling* refers to associations between two or more forms of processing within or across domains of functioning, such as concurrent covariation, lead-lag relations, and synchronization, at identical, different, or hierarchically nested timescales.

The COGITO Study

The Intra-Person Dynamics project aims at thoroughly investigating the differences and commonalities between covariance structures of intellectual abilities measured across individuals at a given occasion and across occasions within a given individual. Most existing research on intellectual abilities assumes that covariance structures based on interindividual (i. e., between-person) differences general-

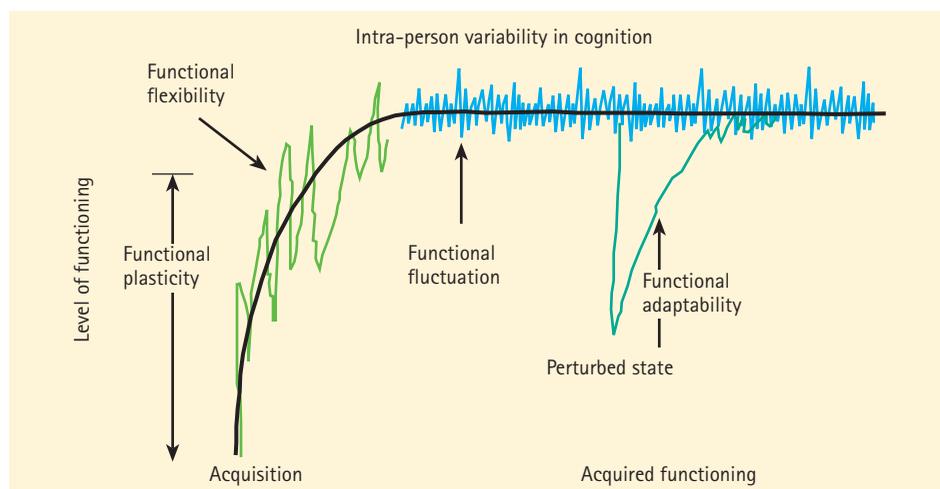


Figure 14. Types of intra-person variability in cognitive functioning (adapted from Li, Huxhold, & Schmiedek, 2004).

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ize to intraindividual (i. e., within-person) structures. However, as Raymond B. Cattell, Jacques Lautrey, John Nesselroade, Peter Molenaar, and others have argued for a long time, differences between within-person and between-person structures are perfectly possible. Conceptually, the malleability of functional organization at both behavioral and neuronal levels and the diversity of developmental trajectories and life experiences render any strict congruence between within- and between-person structures unlikely. The main empirical study of the Intra-Person Dynamics project, labeled the **Cognition Ergodicity Study of the MPI for Human Development or COGITO ERGO SUM**, or even shorter the COGITO study, was started in 2006 and completed toward the end of 2007. One hundred and one younger adults aged 20–31 years and 103 older adults aged 65–80 years participated in 100 daily sessions, working each day on a set of 12 cognitive tasks comprising perceptual speed, episodic memory, and working memory (see Figure 15). Self-report measures of stress, affect, motivation, and self-regulation were also assessed on a daily basis. In addition, all participants completed comprehensive pretests and posttests with baseline measures of cognitive abilities and transfer tasks for the practiced abilities. In subsamples, brain-related measures

were taken at pretest and posttest, including structural magnetic resonance imaging (MRI), functional MRI, and electroencephalographic (EEG) recordings. The study was preceded by extensive pilot work to validate the measures and examine their multivariate structure (e. g., Schmiedek, Hildebrandt, Lövdén, Wilhelm, & Lindenberger, 2009).

In the period 2009–2010, a 2-year follow-up was conducted, in which another repeat of the posttest assessment and 10 daily sessions were included to investigate maintenance of training and transfer effects as well as the relation of short-term fluctuations to changes over longer time intervals. Furthermore, COGITO participants were included in the BASE-II study (see Project 5, p. 209), thereby taking part in yearly interviews of the German Socio-Economic Panel Study (SOEP) and in an intensive medical examination by the Geriatrics Research Group of the Charité, including blood sampling for whole-genome scan analyses. Information from the SOEP will allow a description of the representativeness of COGITO participants regarding sociodemographic variables and well-being as well as investigating changes in these variables over several years. The combination of medical and genetic information from BASE-II with the uniquely intense behavioral assessments from COGITO will provide a rich resource for

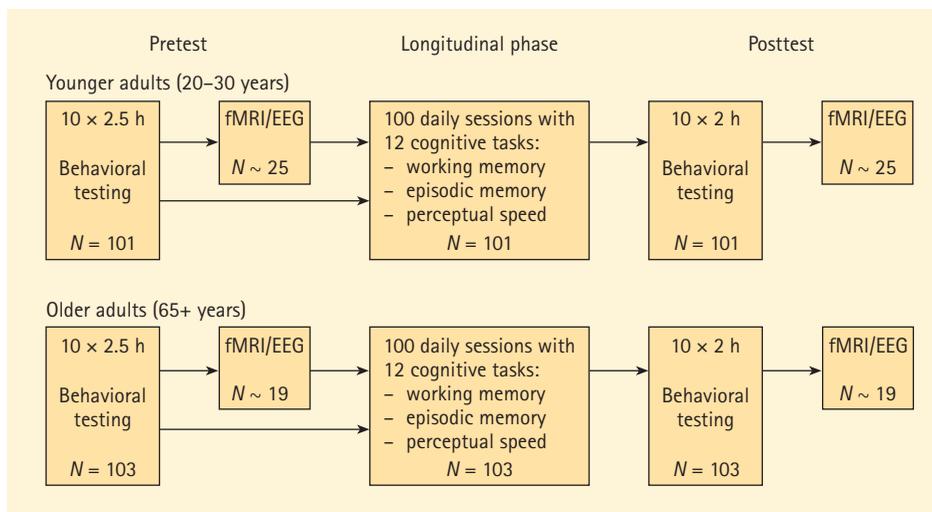


Figure 15. The experimental design of the COGITO study.

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future explorations of adult development at behavioral, neural, and somatic levels. Current data analysis aims at systematically examining differences and commonalities between covariance structures of intellectual abilities measured either (a) across individuals at a given occasion or (b) across occasions within a given individual. First results pertaining to the (non-)equivalence of between- and within-person relations of different variables come from analyses of reaction time (RT) on an n-back working memory task. While between-person analyses tend to show or assume that means and standard deviations of RT distributions are linearly related to each other, analyses of the within-person relations across 100 days in COGITO revealed that this relation differed considerably across individuals and age groups (see Figure 16; cf. Schmiedek, Lövdén, & Lindenberger, 2009).

Regarding analyses of the multivariate structure of cognitive tasks in COGITO, project members are currently working on the development and adaptation of existing multivariate time series and structural equation models to allow direct comparisons of between- and within-person structures. To this end, we focus on approaches that permit the simultaneous estimation of between- and within-subject structures to gain a deeper understanding of the degree of factorial (in)variance. In addition, methods are being explored that allow a better adaptation to the specific features of this study in terms of complex error structures and unequal measurement intervals. Furthermore, the COGITO study also provides a unique opportunity to address the question of practice-induced cognitive plasticity because the amount (100 one-hour sessions), breadth (12 different tasks covering a broad range of cognitive abilities and contents), and demand

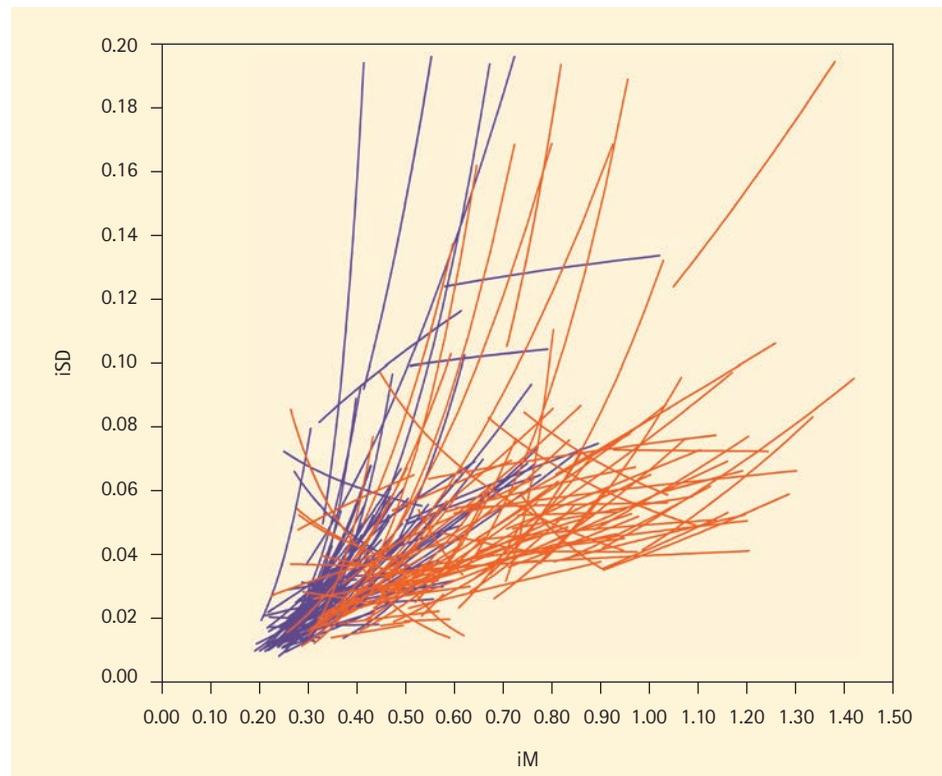


Figure 16. The relation of intraindividual reaction time means (iM) to intraindividual reaction time standard deviations (iSD). Functions were fitted to individual time-series data from about 100 daily occasions using multi-level models with a power function relating mean performance to intraindividual variability. Blue lines: younger adults; Red lines: older adults (adapted from Schmiedek et al., 2009).

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characteristics of the training schedule, when considered in combination, is without precedent. To estimate the size of training and transfer effects due to training, age-matched control groups of 44 younger and 41 older adults took part in pretest and posttest measurements separated by a delay comparable to the main study group. Going beyond earlier attempts to determine the breadth of transfer effects, we included a broad battery of potential transfer tasks, covering different near and far ability constructs. The number and heterogeneity of transfer tasks allowed us to investigate transfer effects at the level of latent factors, which, in our view, is a necessary condition for the interpretation of positive transfer of training as improvements in cognitive abilities, rather than in task-specific skills (Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010; Noack, Lövdén, Schmiedek, & Lindenberger, 2009). In addition to (a) improvements of practiced tasks,

(b) subjective improvements of everyday cognitive performances (Schmiedek, Bauer, Lövdén, Brose, & Lindenberger, 2010), and (c) transfer effects at the level of individual tasks, the study also revealed, arguably for the first time ever, (d) transfer effects at the level of abilities for working memory in older adults as well as for working memory, reasoning, and episodic memory in younger adults (see Figure 17; Schmiedek, Lövdén, & Lindenberger, 2010). This finding fosters hope that intensive training interventions might improve cognitive functioning in adulthood in a way that benefits everyday cognitive performance. In subgroups of younger and older adults who took part in MRI assessments, these findings were complemented by training-induced improvements in the integrity of anterior parts of the corpus callosum (Lövdén, Bodammer et al., 2010). Another topic of the COGITO study is the investigation of intraindividual couplings within

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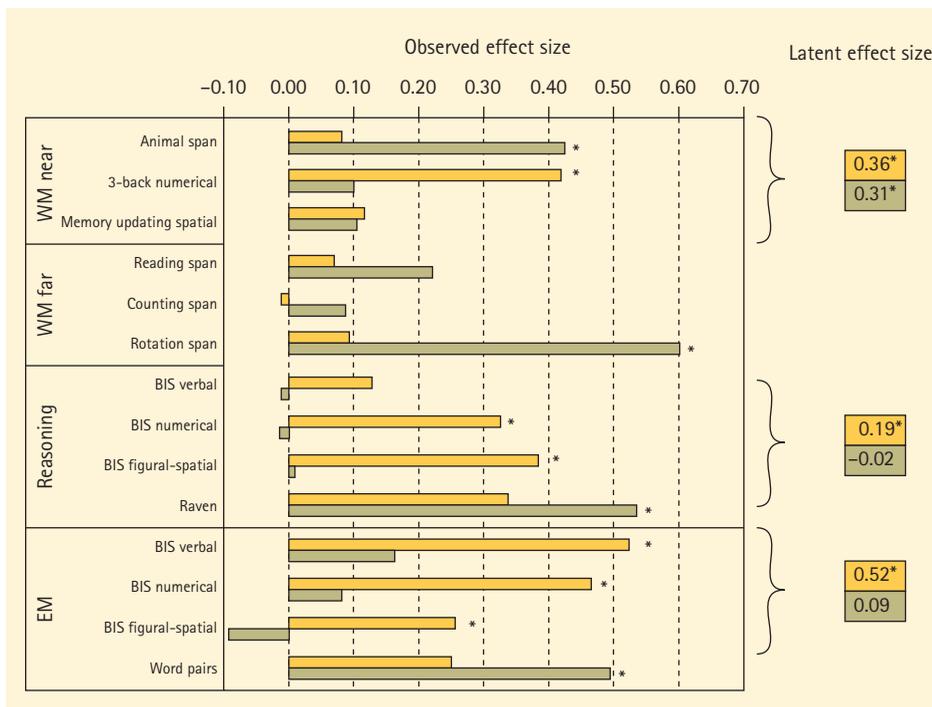


Figure 17. One hundred days of cognitive training enhance broad cognitive abilities in adulthood. Observed and latent net effect sizes of performance gains from pretest to posttest for working memory (WM), Gf/reasoning, and episodic memory (EM). Bars show net effect sizes (standardized changes in the experimental group minus standardized changes in the control group) for individual tasks, separately for younger (orange bars) and older (green bars) adults. Statistically significant net effect sizes correspond to reliable interactions ($p < .05$) between group (experimental vs. control) and occasion (pretest vs. posttest) (adapted from Schmiedek et al., 2010).

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and across psychological domains, specifically between cognitive performance, motivation, affect, and stress. We assume that the ups and downs of daily life, potentially caused by exposure to stressful events, require regulatory effort. Whereas such regulation may result in successful adaptation, it might have detrimental effects on cognitive performance if it draws on attentional or motivational resources. Hence, one research goal was to identify adult age differences in the stress process, in particular in couplings between stressors, affect, and intrusive thoughts (Brose, Schmiedek, Lövdén, & Lindenberger, in press). Results showed decreased affective reactivity to daily stressors in older as compared to younger adults and an age-invariant increase in intrusive thoughts on stressor days. However, the experience of stressor-related intrusive thoughts was less detrimental for older adults; the decrease in mood when experiencing above-average intrusive thoughts was less pronounced in older adults relative to younger adults.

While the preceding analyses took a sample-based approach for analyzing data (i.e., multilevel modeling), our investigation of cognition–motivation couplings used a person-specific method (i.e., P-technique factor analysis). We proposed an average decrease in the intraindividual coupling between motivation and working memory performance because both controlled processing,

and day-to-day variability in motivation are reduced in old age. On average, the reliability-adjusted correlations between motivation and working memory were indeed lower in older adults than in younger adults. Furthermore, within-person structures differed reliably across individuals, defying the assumption that within- and between-person patterns of covariation are alike (see Figure 18; Brose, Schmiedek, Lövdén, Molenaar, & Lindenberger, 2010).

Ongoing data analysis projects include within-person relations at the day-to-day level of subjective health, affect, and social support (Dissertation Julia K. Wolff), individual differences in within-person structures of affective experience, between- and within-person variability in task-related strategies during 100 days of practice, and the relation of variability at shorter time scales (i.e., moment-to-moment fluctuations of cognitive performance) to daily variability and practice-induced changes.

In summary, the data of the COGITO study provide a full data cube of persons \times time points \times variables as envisioned by Raymond B. Cattell. This will open up new data-analytic approaches and allow new insights into between-person differences in within-person variability and change.

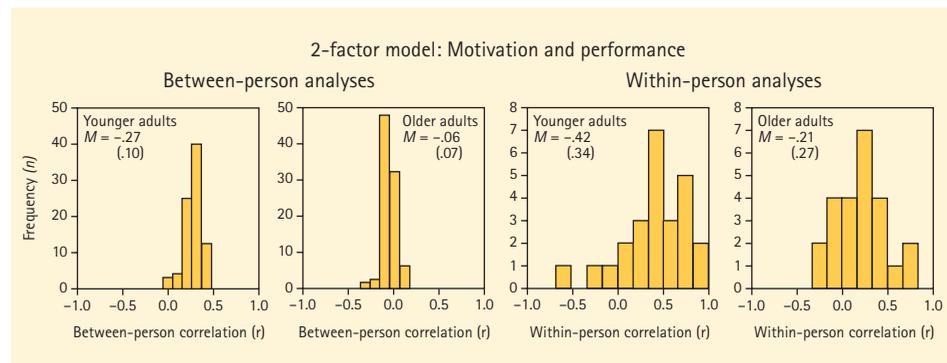


Figure 18. P-factor analyses reveal age group differences and heterogeneity of performance–motivation relations. Distributions of factor correlations (motivation and working memory performance; confirmatory factor analysis), separately for younger and older adults; coefficients were derived for each of 100 study days and for 182 individuals (101 younger and 81 older adults) (adapted from Brose et al., 2010).

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Research Project 3: Cognitive and Neuronal Dynamics of Memory Across the Lifespan (ConMem)

Memory Development as the Interplay of Strategic and Associative Components Across Multiple Levels

The brain operates and changes with age in a distributed and parallel fashion. Mechanisms related to maturation, learning, and senescence affect different regions of the brain on multiple and interacting levels, dimensions, time scales, and trajectories. Behavioral and neuronal evidence suggests that memory functioning requires oscillatory interactions in a distributed network comprising, among others, prefrontal (PFC), medio-temporal (MTL), and parietal regions. The overarching objective of the Cognitive and Neuronal Dynamics of Memory Across the Lifespan (ConMem) project is to provide mechanistic and process-oriented explanations for developmental changes in memory functions. We aim to advance knowledge about the dynamic structure–function dependencies underlying the interplay between memory processes and related neuronal mechanisms.

According to the project's guiding conceptual framework, maturational, experience-dependent, and senescent forces exert their influences on the varying contribution of associative and strategic components during memory encoding, consolidation, and retrieval (cf. Shing, Werkle-Bergner, Li, & Lindenberger, 2008; Werkle-Bergner, Mueller, Li, & Lindenberger, 2006). The associative component of memory refers to mechanisms during encoding, consolidation, and retrieval that bind different aspects of an event into a cohesive memory representation. The associative component can be linked to the functioning of the MTL (especially the hippocampus) and posterior association areas. It is assumed that synchronized activity within and between neuronal networks acts as a binding mechanism in the service of episodic memory. The *strategic component*, on the other hand, refers to control processes that aid and regulate memory functions at both encoding and retrieval. These processes may include elaboration and organization of memory content at encoding, and specification, verification, monitoring, and evaluation of relevant information at retrieval. The functioning of the strategic component is closely related to attentional and control mechanisms mainly supported by PFC regions.

As both components rely on partially overlapping and interactive neuronal circuitries, their functioning is highly interdependent, posing an intricate challenge for empirical investigations (e. g., Shing, Werkle-Bergner,

Brehmer, Mueller, Li, & Lindenberger, 2010). We recently proposed a conceptual framework of episodic memory development that predicts a lifespan dissociation between strategic and associative memory components (Shing et al., 2008; Werkle-Bergner et al., 2006). With respect to childhood, we assume that the protracted maturation of prefrontal regions and associated neural pathways limits the efficiency of the strategic component in children relative to young adults. In contrast, we assume that the associative component, which primarily involves the MTL, is close to fully functional by middle childhood. For old age, the framework postulates deficiencies in both components relative to early adulthood, reflecting senescent alterations in PFC and MTL regions of the brain and related neuronal circuits. The predicted lifespan dissociation between the two components provides a starting point to identify mechanisms of lifespan changes in various forms of memory, including episodic memory and working memory.

Neuronal Correlates of Episodic Memory Encoding

This part of the project seeks to closely examine the relative contributions of strategic and associative components to lifespan differences in episodic memory. In an initial behavioral study, demands on associative and strategic components were systematically manipulated with an associative recognition memory task in a within-person repeated-measures design

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Thomas Grandy
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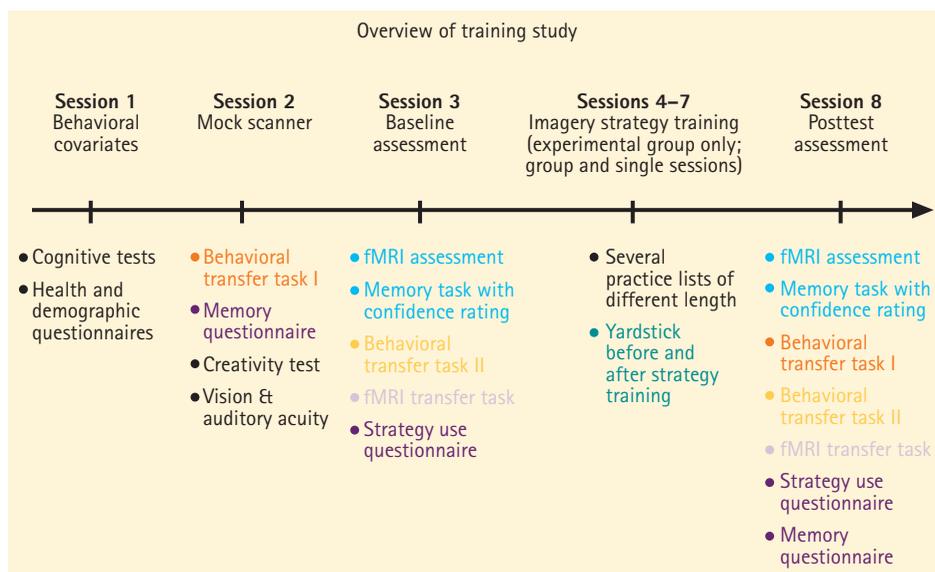


Figure 19. Overview of a multisession training study of lifespan differences in episodic memory. Children aged 9–10, younger adults aged 20–25, and older adults aged 63–70 years assigned to experimental or control groups participated in eight or four sessions of testing, respectively. The data will allow us to examine age differences in neural activation patterns of successful encoding.

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(Shing et al., 2008). Results of this study are consistent with the two-component model of episodic memory development across the lifespan. While both children and older adults benefited from strategic instruction, children show higher latent potential for associative binding than older adults after overcoming their difficulty in implementing and effectively using a mnemonic strategy (cf. Shing & Lindenberger, in press).

Inspired by these promising results, the project has launched a new line of research to directly examine age differences in brain activation patterns of successful memory encoding. This research combines multi-session training procedures with functional neuroimaging techniques (fMRI) and is being conducted together with Yvonne Brehmer and Lars Bäckman from the Karolinska Institute at Stockholm (see overview of design in Figure 19). A major goal of this work is to find out whether age-group differences in patterns of brain activation during successful episodic memory formation are consistent with the two-component model. The question whether training-related changes in neural activation during successful memory

encoding differ by age is of special interest. For instance, we predict that children's brain activation patterns during successful memory encoding may become more similar to those of younger adults in the course of training, while older adults continue to show reduced activation in the hippocampus due to their deficits in the associative component. Data collection and analysis are currently underway. Preliminary behavioral analyses confirm the effectiveness of the imagery-strategy training in boosting performance in individuals of all ages.

High-Confidence Errors and Age Differences in Retrieval Processing

The ability to calibrate the subjective confidence of one's memories to their objective accuracy is a central aspect of memory monitoring and of relevance for everyday life. In an initial study, we examined lifespan differences of confidence calibration in episodic memory, particularly the susceptibility to high-confidence errors in children, teenagers, younger adults, and older adults (Shing, Werkle-Bergner, Li, & Lindenberger, 2009). Our results show that older adults are

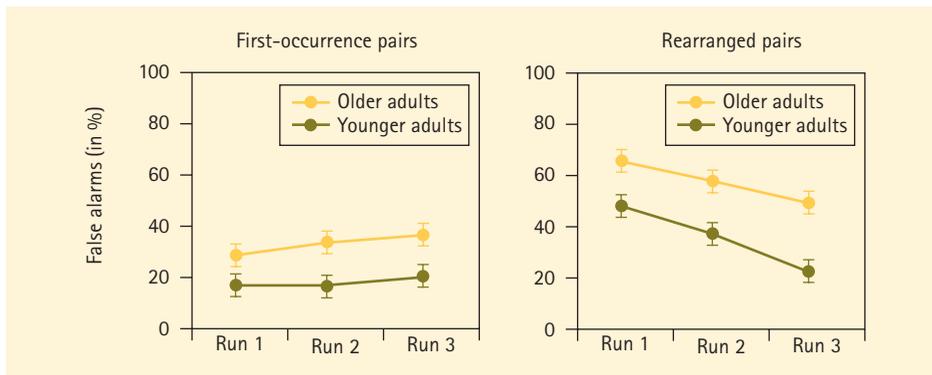


Figure 20. Percentage of falsely recognized first-occurrence and rearranged pairs for younger and older adults. Older adults show deficits in memory control and monitoring mechanisms as demonstrated by their increasing false recognition across runs. In addition, they face an associative deficit as demonstrated by their persistently high false-alarm rate for rearranged pairs. Error bars represent standard error of the mean.

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disproportionately more likely to indicate high confidence following false alarms to lure pairs than participants of the other three age groups. This difference does not disappear, even after strategy instructions and practice. To follow up on these findings, we initiated a series of experiments including functional neuroimaging techniques to further examine the high-confidence error phenomenon (Dissertation Yana Fandakova). These experiments will address: (a) how memory monitoring and control mechanisms contribute to age differences in false recognitions; (b) whether changes in the PFC-MTL-parietal memory retrieval network underlie age differences in false alarms, particularly false alarms accompanied by high confidence. To this end, we tested 28 younger adults and 30 older adults using a modified version of a continuous recognition task. In this task, participants saw the same set of word pairs in three subsequent runs and had to identify pairs that were repeated within runs. Results of the study show that false recognition increased across runs of the task for older but not younger adults, indicating that memory control and monitoring mechanisms during retrieval of highly familiar events are compromised in old age (see Figure 20). Furthermore, across runs of the task, younger adults showed a more pronounced decrease in false recognition of rearranged pairs compared to older adults, suggesting that additional

associative deficits contribute to age differences in recall-to-reject processes (Shing et al., 2010). Older adults were more likely than younger adults to commit false alarms with high confidence, indicating that overall memory-confidence calibration functions less accurately in old age. Analyses of the neuronal mechanisms underlying age-related deficits in memory monitoring are currently underway.

The Contributions of Hippocampal Subfields to Age Differences in Memory

The hippocampus (HC) is a heterogeneous structure that consists of cytoarchitectonically distinct regions or subfields. Intriguingly, animal studies as well as neurocomputational modeling work suggest specific functional roles for the diverse subfields in memory formation, consolidation, and retrieval. Nevertheless, until recently, the cytoarchitectonic heterogeneity of the HC presented a challenge for in-vivo measurement in humans. By combining manual tracing techniques (see Figure 21a) with spatial high-resolution structural imaging of the medio-temporal lobes, we recently examined age-related regional volume differences as well as the relationship between the volume of HC subfields and their contribution to associative episodic memory performance in healthy older adults. Work in this area entails close collaborations with Nils C. Bodammer (MRI physicist at this

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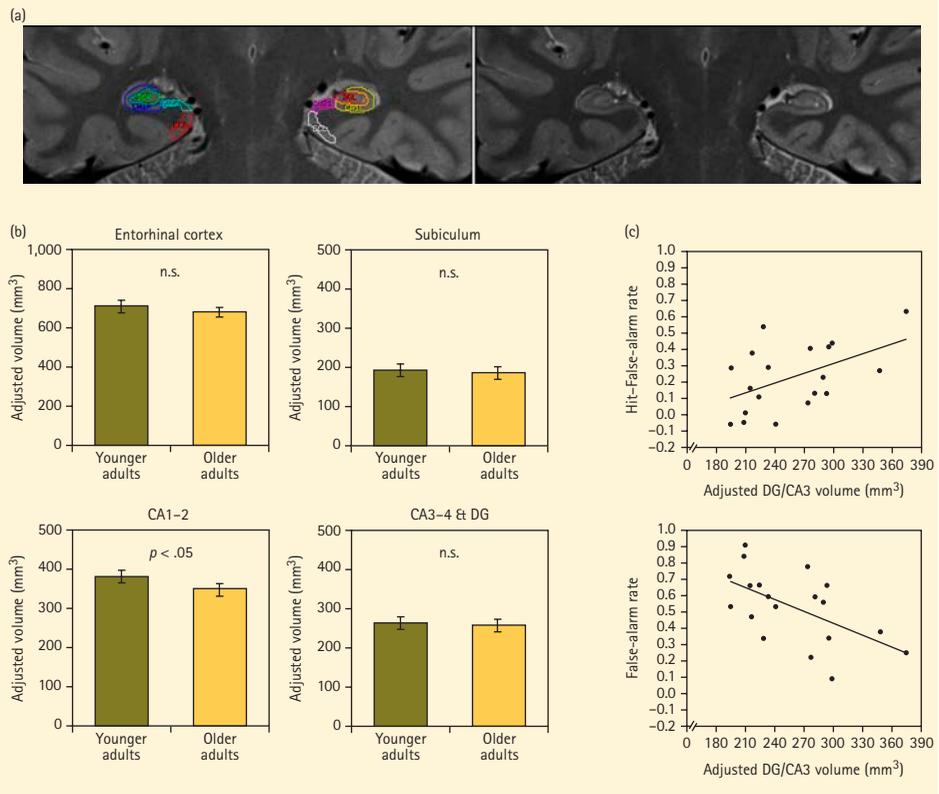


Figure 21. Hippocampal subfields and age differences in associative memory. (a) Example of hippocampal subfields tracing. Starting slices with tracing (left) and without tracing (right) are shown. (b) Hippocampal subfield volumes in younger and older adults. Age group differences in volume were reliable for subfield CA1-2. Volumes were adjusted for intracranial volume. The error bars represent standard errors of the mean. (c) Relation between memory performance and CA3-4 & DG volume. Larger CA3-4 & DG is associated with better memory performance (upper panel) and, in particular, lower false-alarm rate (bottom panel; adapted from Shing et al., 2011).

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Center), Naftali Raz (Wayne State University), Karen M. Rodrigue, and Kirsten M. Kennedy (both from University of Texas at Dallas). In line with previous reports, the cornu ammonis sectors 1 and 2 (CA1-2) were the only regions that exhibited age-related volume differences (see Figure 21b). However, smaller CA1-2 volumes were present in hypertensive older adults only, whereas normotensive participants did not reliably differ in CA1-2 volumes from younger adults. Within the group of older adults, individual differences in the volume of the dentate gyrus (DG) plus CA3-4 were correlated with individual differences in associative memory performance (see Figure 21c; Shing et al., 2011). Specifically, the larger the volume of CA3-4 & DG, the lower the likelihood of committing false-alarm

errors in response to rearranged lure pairs. This finding is in line with the suggested role of DG in generating distinct representations from overlapping input patterns (a mechanism termed pattern separation). Thus, the results highlight the importance of structural integrity of the CA3-4 & DG region in the context of recognizing changes (rearranged lures) in familiar stimuli. We are currently following up on these initial results by examining age differences in functional activation patterns. To this end, we will combine fMRI adaptation paradigms with high-resolution functional and structural HC imaging. Manual tracing will be used for exact delineation of the various HC subfield borders. Examining stimulus-specific modulations in neuronal activation due to repeated

exposure of the same stimuli and slightly different lure items will help to elucidate how normal aging alters the contributions of HC subfields to pattern separation and pattern completion.

Mechanisms and Limits of Working Memory Across the Lifespan

Working memory (WM) is one of the most basic cognitive functions, enabling flexible adaptation to changing environments. The ability to select relevant and ignore irrelevant information appears critical for an individual's range of effective WM performance. Inspired by the striking similarity of neuronal circuits involved in WM and episodic memory, this part of the project aims to extend the framework of associative and strategic components to understand lifespan age differences in WM functioning.

At present, little is known about age-dependent changes in selective filtering and capacity limits in WM and associated changes in the large-scale dynamics of neuronal networks. Therefore, we conducted a series of behavioral and electroencephalographic (EEG) studies with lifespan samples that varied the demands on low-level feature binding and strategic control processes by means of presentation time and WM load manipulations (Dissertation Myriam C. Sander). The behavioral results lend support to the assumption of a lifespan dissociation of associative and strategic components in the domain of WM functioning (see Figure 22a). Under task conditions demanding fast low-level binding operations (i. e., with short presentation times), children's performance resembles the performance of young adults, whereas older adults show disproportionate performance deficits (see Sander, Werkle-Bergner, & Lindenberger, in press). With regard to neuronal markers of WM functioning, we were able to demonstrate reliable posterior EEG activity related to attentional top-down modulation in all three age groups.

Another line of research in this area explores the large-scale dynamics of neuronal networks during selection and encoding of information for WM maintenance in younger and older adults. To examine age differences in oscillatory brain dynamics, participants saw randomly intermixed series of items that should either be maintained in WM (REM) or should be discarded (notREM) from further processing. Increased oscillatory activity in lower frequency ranges (~5–15 Hz) was related to the successful suppression of notREM items. At the same time, increased phase synchronization of brain oscillations in response to REM items (Figure 22b) was selectively correlated with successful WM performance in younger but not in older adults (Figure 22c). Together with previous studies (see Werkle-Bergner, Shing, Mueller, Li, & Lindenberger, 2009), these findings point to profound changes in perception and attention from early to late adulthood. Sparse representational schemes based on temporally synchronized neuronal interactions are likely to develop through experience in the course of ontogeny. We tentatively propose that senescent declines in neural density, and neurotransmitter availability may increase rather than decrease the reliance on temporally synchronized processing. As a result, oscillatory brain dynamics in older adults may be more vulnerable to entrainment by external sensory input, possibly resulting in differentiated representations (see also Mueller, Gruber, Klimesch, & Lindenberger, 2009). These conjectures will be further tested in our future work, partly in collaboration with Wolfgang Klimesch (University of Salzburg). We also plan to add ecological validity to this line of research by examining the attentional demands of assistive way-finding technologies in virtual reality environments. This work entails collaboration with Michael Schellenbach (see Project 4, pp. 201–206).

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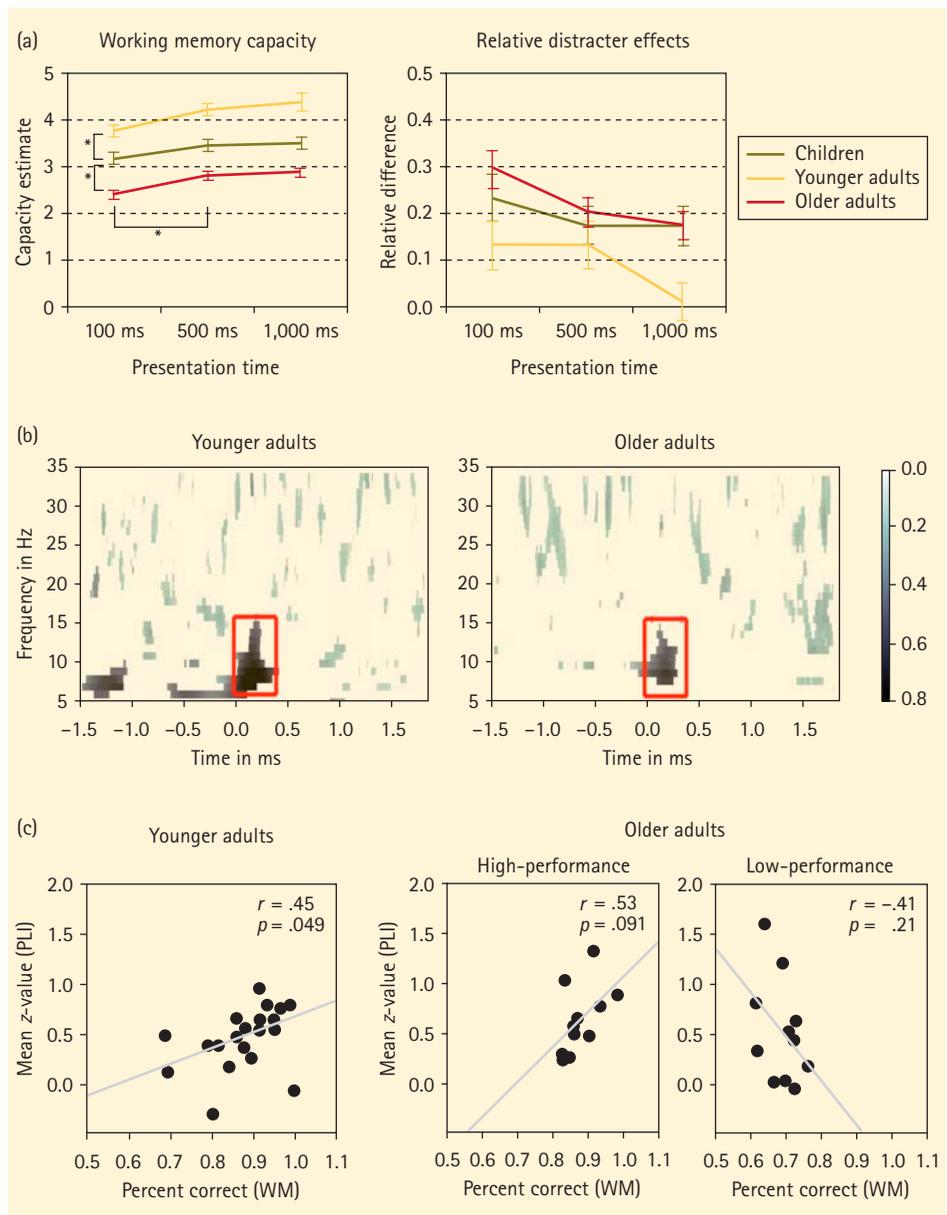


Figure 22. Working memory (WM) in children, younger adults, and older adults. (a) Lifespan age differences in WM capacity (left panel) as a function of presentation time condition. Simultaneous presentation of distracters (right panel) affects WM processing differently in children, younger adults, and older adults, depending on time constraints during encoding (adapted from Sander et al., in press). (b) Younger and older adults show comparable increases in phase synchronization during the encoding of relevant, compared to irrelevant, information. (c) Despite the similarity between younger and older adults shown in (b), the difference (REM–notREM) in phase stability predicts WM performance only in young and high-performing older adults, but not in older adults with lower performance levels. (The parametric correlations and p -values are shown. The reliability of the correlational patterns for younger and high-performing older adults was confirmed by nonparametric bootstrap procedures to attenuate effects of outliers in small samples.)

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Research Project 4: Sensorimotor–Cognitive Couplings

Conceptual Overview

Everyday life often requires the integration of multiple sensory inputs and concurrent coordination of sensorimotor and cognitive demands. Examples are walking while trying to memorize a shopping list, maintaining one's balance on a bus while trying to read an advertisement, or trying to remember the way to a friend's house while driving in the hectic morning traffic. Everyday observation further suggests that older adults and young children need to invest more attention into sensorimotor aspects of their behavior than teenagers and young adults. For example, when facing an obstacle on a narrow path, older adults may tend to stop talking and resume their conversations after the obstacle has been overcome, whereas the same obstacle will affect younger adults' conversation to a lesser extent. How do individuals of different ages adapt to multiple sensorimotor and cognitive demands? How does the interaction between sensorimotor and cognitive dimensions of behavior change across the lifespan?

The Sensorimotor–Cognitive Couplings project seeks to provide answers to these questions by focusing on motor aspects of behavior, both in isolation and in relation to cognitive task demands. The project investigates (a) lifespan differences in interactions between sensorimotor and cognitive aspects of behavior (e. g., Schaefer, Huxhold, & Lindenberger, 2006), (b) lifespan differences in movement organization (e. g., Verrel, Lövdén, & Lindenberger, in press), and (c) the use of assistive technologies in old age (e. g., Schellenbach, Lövdén, Verrel, Krüger, & Lindenberger, 2010b). The three areas of emphasis are

reflected in the structure of the project, which is organized into three interrelated subprojects.

The Movement Lab

Our laboratories are equipped with advanced motion capture systems and integrated synchronized assessments of biosignals, such as electroencephalography (EEG) and electromyography (EMG). To visualize a participant's movement, for instance, while walking, markers reflecting infrared light are attached to his or her body (see Figure 23). Multiple cameras capture the position of the markers, which are



Figure 23. A young adult walking on the treadmill through a virtual world. Reflective markers and a system of infrared cameras allow for the analysis of gait characteristics and for the adaptive regulation of treadmill speed.

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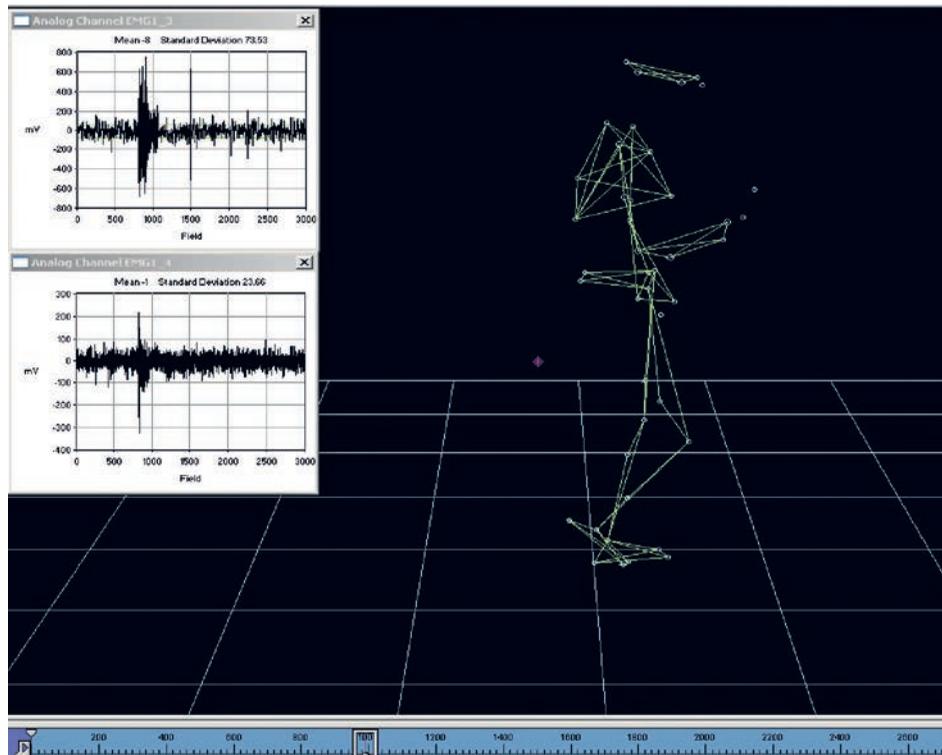


Figure 24. Motion captures of an individual walking on the treadmill and holding a mobile device to assist navigation performance. The positions of the reflective markers attached to the body of the participant are captured by several infrared cameras and postprocessed according to biomechanical models to arrive at a dynamic visualization of the participant's movements. The two boxes depict a simultaneously recorded EMG signal from the right arm.

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then postprocessed offline according to biomechanical models. This procedure allows for visualization of the participant's movement patterns and for the fine-grained analysis of interlimb coordination underlying successful motor performance. Figure 24 shows motion captures of an individual walking on the treadmill while holding a mobile device to assist navigation performance.

To investigate locomotion behavior under conditions that more closely approximate everyday behavior, we developed a set of virtual environment paradigms with a walking component. In most cases, scenery is projected in front of a treadmill, and the movement of the treadmill is synchronized to the visual flow of the scenery so that participants have the impression of actually walking through a virtual environment. In some of the more recent studies, the treadmill modifies its speed according to participants' walking

speed. Also, in some experimental conditions, participants are instructed to remain within the boundaries of a narrow virtual track and receive feedback about their missteps on the screen (Figure 25).

Experimental paradigm development has aimed at evaluating new types of assistive technology in the context of the treadmill virtual reality laboratory (see Figure 23). For instance, in a validation study, we examined younger and older adults' ability to habituate to the treadmill environment (Schellenbach et al., 2010a). We also improved the treadmill interface that allows for feedback-controlled locomotion within the virtual reality. In future work, we will explore the use of oscillatory EEG measures related to attention and working memory load as signals for adaptive assistive technologies (see Figure 26). This work entails collaboration with Markus Werkle-Bergner (see Project 3, pp. 195–200).



Figure 25. Example of a virtual world projected onto a large screen in front of the treadmill. The task consists of balancing on a narrow track as quickly and accurately as possible under single- and dual-task conditions. Treadmill speed is constantly adjusted to each individual's performance, and a red bar lights up whenever a participant has committed a misstep (e.g., by leaving the boundaries of the virtual track).

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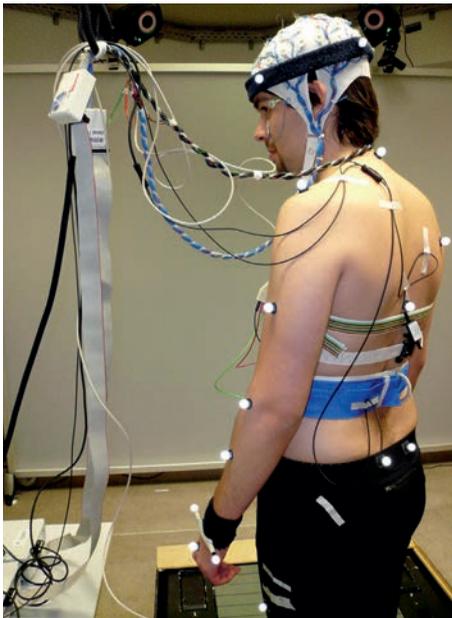


Figure 26. A young adult equipped with EEG and ECG sensors as well as reflective markers in preparation for a walk on the treadmill to measure gait characteristics and attention.

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Subproject 1: Integration and Competition Between Cognitive and Motor Aspects of Behavior

In earlier work, we showed that older adults invest more cognitive resources into motor aspects of behavior than younger adults, presumably to attenuate the adverse effects of sensorimotor decline, leading to higher dual-task costs when a cognitive and a motor task need to be performed concurrently. For instance, we found that older men profited from the possibility of holding a handrail while finding their way in a virtual museum, while there was no difference in way-finding performance for younger men walking with or without support (Lövdén, Schellenbach, Grossman-Hutter, Krüger, & Lindenberger, 2005). In a related study, we also found that walking with navigation load increased older adults' but not younger adults' trunk-angle variability (Schellenbach et al., 2010a). However, sensorimotor-cognitive dual-task situations do not always lead to performance reductions. In conditions in which the mo-

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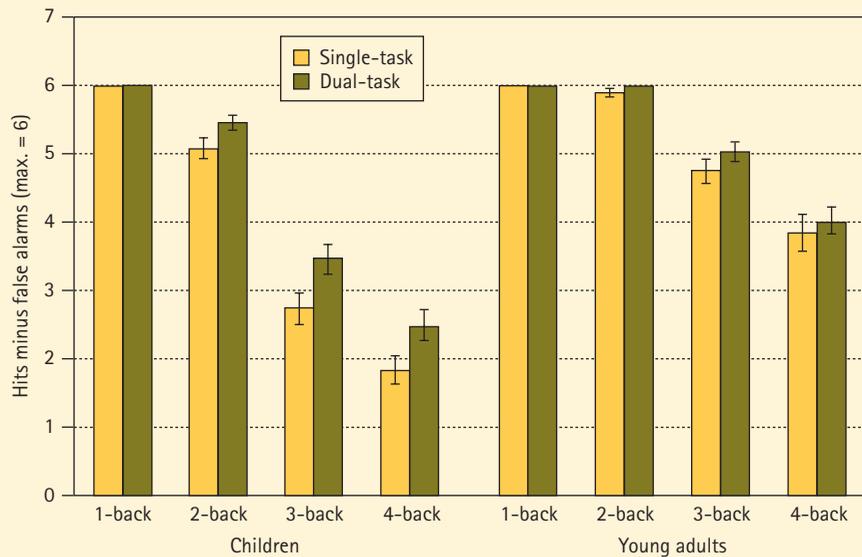


Figure 27. Cognitive performance when sitting (yellow bars) as compared to walking (green bars) with preferred speed. Children and young adults show higher working memory scores when walking, indicating that their cognition can profit from continuous body movements. Error bars = standard error of the mean (adapted from Schaefer et al., 2010).

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tor task is highly automatized and usually smoothly executed without conscious control, focusing one's attention on the motor task may lead to performance decrements. For example, in 2006, Oliver Huxhold and colleagues observed that both younger and older adults show more sway when exclusively focusing on the balance task than when concurrently performing an easy cognitive task. In older adults, body sway increased again when the difficulty of the cognitive task was increased, presumably reflecting cross-domain resource competition. We replicated these findings for treadmill walking, where a principal component analysis based on gait patterns revealed a U-shaped pattern for residual whole-body variability in the oldest age group (Verrel, Lövdén, Schellenbach, Schaefer, & Lindenberger, 2009). The principal component analysis subtracts the regular from the irregular components of whole-body motion, and the residual variance can be interpreted as an index of gait irregularity. We conclude that normal aging is associated with alterations in the trade-offs between two continuous control processes involving positive effects of

external focus of attention and negative effects of resource competition, respectively. Our work on the relation between body movement and cognitive load also includes children. Despite having fewer cognitive and sensorimotor resources available than young adults, children do not always show performance decrements in sensorimotor-cognitive dual-task situations, and sometimes even profit from the concurrent performance of an additional task. In a study asking 9-year-olds and young adults to walk on a treadmill while performing a working memory (n-back 1 to 4), children tended to increase their gait variability with increasing working memory load (Schaefer, Lövdén, Wieckhorst, & Lindenberger, 2010). In the cognitive domain, however, both children's and young adults' working memory performance was actually *higher* when walking than when sitting on a chair, but only if individuals were walking on the treadmill at their preferred speed (see Figure 27). Cognitive performance did not improve when the treadmill had a fixed speed of 2.5 km/h, suggesting that the adjustment of one's walking speed to the speed of the

treadmill may require attentional resources. Thus, at least in children and young adults, cognitive performance may benefit from periodic forms of body movement. In future research, Sabine Schaefer and colleagues will investigate how automaticity and arousal differentially influence sensorimotor-cognitive dual-task performances across the lifespan. In addition, they will seek to identify the mechanisms underlying integration versus competition of motor and cognitive aspects of behavior in greater detail.

Subproject 2: Organization of Movement Variability

The principal-component analyses of gait regularity performed by Verrel et al. (2009) show that advanced methods for movement analysis, preferably based on dynamic theories of motor behavior, are crucial for detecting age-related changes in motor behavior as well as their interaction with cognitive demands. In his dissertation project, Julius Verrel investigated adult age differences in the organization of movement variability. Depending on its organization, movement variability can

point to performance flexibility and stability, or to poor motor control. This “dual nature” of movement variability reflects that most motor tasks can be achieved with a variety of body configuration (“motor equivalence”). In line with these considerations, an age-comparative study on manual pointing (Verrel et al., in press), older and younger adults showed similar performance accuracy. However, the older adults made less use of goal-equivalent (“flexible”) variability, suggesting that they were relying on a compensatory strategy (reduction of execution variability) to ensure end point accuracy (see Figure 28). Subsequent studies applied similar considerations and data-analytic methods to the more complex motor activity of walking. Successful walking requires continuous stabilization of multiple performance constraints, such as whole-body balance, orientation, and maintenance of a regular step pattern. In a first study with young adults only (Verrel, Lövdén, & Lindenberger, 2010), the analysis of movement variability indicated that both center of mass position (related to balance) and step parameters (related to the regular-

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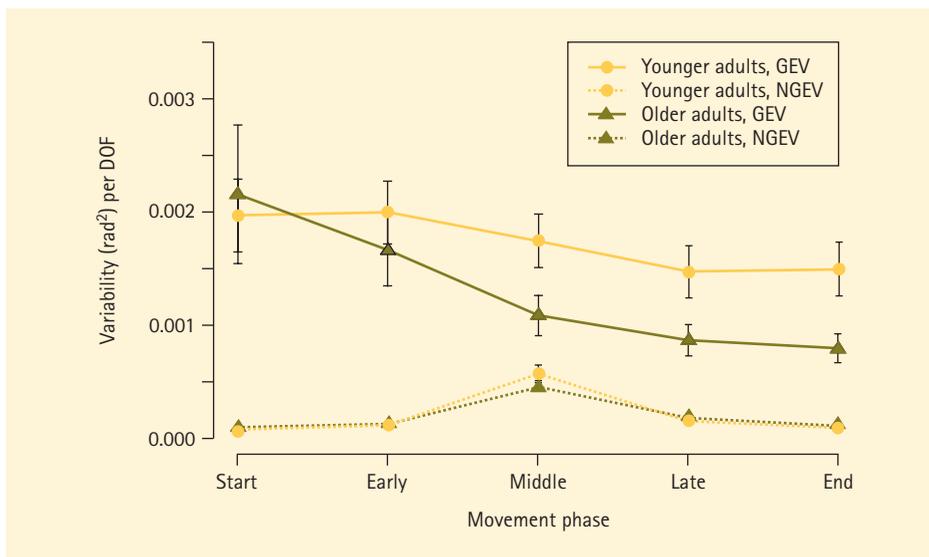


Figure 28. Goal-equivalent (GEV) and nongoal-equivalent (NGEV) variability with respect to fingertip position in younger and older adults at five characteristic time points throughout a manual pointing movement. The fact that GEV is consistently higher than NGEV shows that the fingertip position is stabilized by motor-equivalent coordination. No age differences were found with respect to NGEV, but GEV was lower in older adults toward the end of the movement. DOF: degrees of freedom; error bars = standard error of the mean (adapted from Verrel et al., in press).

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ity of the walking pattern) were stabilized by motor-equivalent coordination, and that the strength of the motor-equivalent coordination was higher for the center of mass than for the step-related measures. This pattern of results indicates a prioritization of the functionally most important performance variables. Preliminary results from a second study, comparing healthy young and older adults, suggest that high-performing older adults show preserved balance control and impaired step length control in the motor-equivalent stabilization of gait. This putative prioritization of balance by older adults may reflect successful adaptation to reduced coordinative capacities.

A methodological emphasis of this subproject is on studying formal properties of movement variability. In the uncontrolled manifold (UCM) approach, for instance, variability in elemental variables, such as joint angles or muscle modes, is decomposed into goal- and nongoal-equivalent variability components (GEV, NGEV) with regard to a specified task variable. A UCM effect is present when GEV exceeds NGEV, and different indices have been proposed to quantify the strength of UCM effects. Verrel (2010) proposed variance-stabilizing transformations for each of these indices. Results indicate that the variability components should be log-transformed prior to statistical analysis to reduce nonnormality and inhomogeneity of variances. Moreover, Verrel formally showed that different UCM indices are identical after appropriate variance-stabilizing transformations.

In future empirical studies, Julius Verrel and colleagues will examine functional implications of age-related differences in motor-equivalent coordination, in particular with respect to the ability to flexibly and appropriately respond to external perturbations and the ability to adapt to additional performance constraints.

Subproject 3: Biophysical Signals for Assistive Technologies

The Sensorimotor-Cognitive Couplings project also investigates assistive technology in adulthood and old age (Lindenberger, Lövdén, Schellenbach, Li, & Krüger, 2008). Michael Schellenbach and colleagues seek to identify empirical criteria for net resource release by examining the ways in which navigation aids that differ in cognitive demands improve or harm gait stability in younger and older participants who are trying to find their way in a virtual environment while walking on a treadmill. As expected, results indicate that the effectiveness of different kinds of navigational assistance varies by context and by the individual's sensorimotor and cognitive resources (Schellenbach et al., 2010b). In April 2009, this subproject joined Smart-Senior (www.smart-senior.de), a large-scale consortium of research institutions and companies that is funded by the German Ministry of Education and Research. In the context of this consortium, the subproject will examine how older adults interact with new technologies, in part by carrying out field tests in technologically advanced prototype apartments. For his dissertation, Dominik Jednoralski plans to design a mobile context-aware assistive system with the goal of enhancing objective and subjective aspects of everyday competence in old age. The corresponding smartphone device will monitor the participant's behavior and suggest presumably adaptive or beneficial activities just in time. The underlying contextual suggestion engine will be supported by the continuous modeling of individuals' cognitive and physical functioning.

Research Project 5: The Berlin Aging Studies (BASE)

During the 20th century, average life expectancy nearly doubled. More and more individuals in current cohorts 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. Since 1989, members of the Center for Lifespan Psychology have been investigating age- and death-related changes in psychological functioning from age 70 to 100+ in the context of the Berlin Aging Study I (BASE-I; Baltes & Mayer, 1999). Recently, a new focus has been added by establishing BASE-II.

Berlin Aging Study I (BASE-I): Very Old Age and the End of Life

Longitudinal data in BASE-I are now available for eight measurement occasions spanning more than 18 years, and mortality-related information is updated at regular intervals. Most of the 516 individuals who participated in the 14-session multidisciplinary assessment at the first measurement occasion (T1) about 20 years ago are no longer alive. At the eighth measurement occasion (T8) in the period 2008–2009, 22 surviving participants were reexamined, with a focus on psychological, medical/geriatric, and dental assessments. In the period 2009–2010, the German monograph on BASE-I findings was published in its third edition (Lindenberger, Smith, Mayer, & Baltes, 2010). Two chapters on longitudinal design and findings were added to the original version published by Karl Ulrich Mayer and Paul B. Baltes in 1996 (second edition, 1999). Smith and Delius (2010a) present key features of the longitudinal extension of BASE-I, including study design, organization, and sample attrition. Kotter-Grünn, Kleinspehn-Ammerlahn, Hoppmann et al. (2010) give an overview of the study's longitudinal findings. The authors of this chapter represent the younger generation of BASE-I researchers, and many of them began their careers with the analysis of BASE-I data in their diploma theses and dissertations.

Subjective Evaluations in Very Old Age

An important focus of data analysis has been on various aspects of subjective experience in old age. Kotter-Grünn, Kleinspehn-Ammerlahn, Gerstorff, and Smith (2009) examined satisfaction with aging and younger subject-

ive age as indicators of positive well-being in late life using 16-year longitudinal BASE-I data. Extending previous studies, they found that higher aging satisfaction and younger subjective age but also more favorable change patterns (e.g., less decline in aging satisfaction) are associated with lower mortality hazards. As individuals approach death, however, they become less satisfied with their aging and report feeling older. For aging satisfaction, in particular, mortality-related decline is much steeper than age-related decline (see Figure 29), whereas change in subjective age is best characterized as an age-related process.

In a further study on the prediction of one's own death, Kotter-Grünn, Grünn, and Smith (2010) focused on the relationship between subjective and objective nearness to death in very old age, again using the 16-year longitudinal BASE-I data. They found that older adults who felt close to death at T1 were more likely to die over the following 16 years than persons who did not report feeling close to dying (Figure 30). Results of multilevel analyses revealed that subjective nearness to death increased as a function of objective nearness to death, indicating that very old adults seem to have quite accurate perceptions of their impending death.

Cognitive Aging and Functioning in Other Domains

Lindenberger and Ghisletta (2009) returned to the relation between sensory and cognitive decline in old age, a theme that has played a major role in BASE-I. They found that longitudinal associations between cognitive and sensory declines were only moderate in size.

Researchers

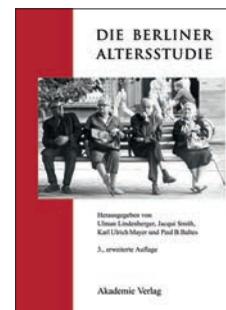
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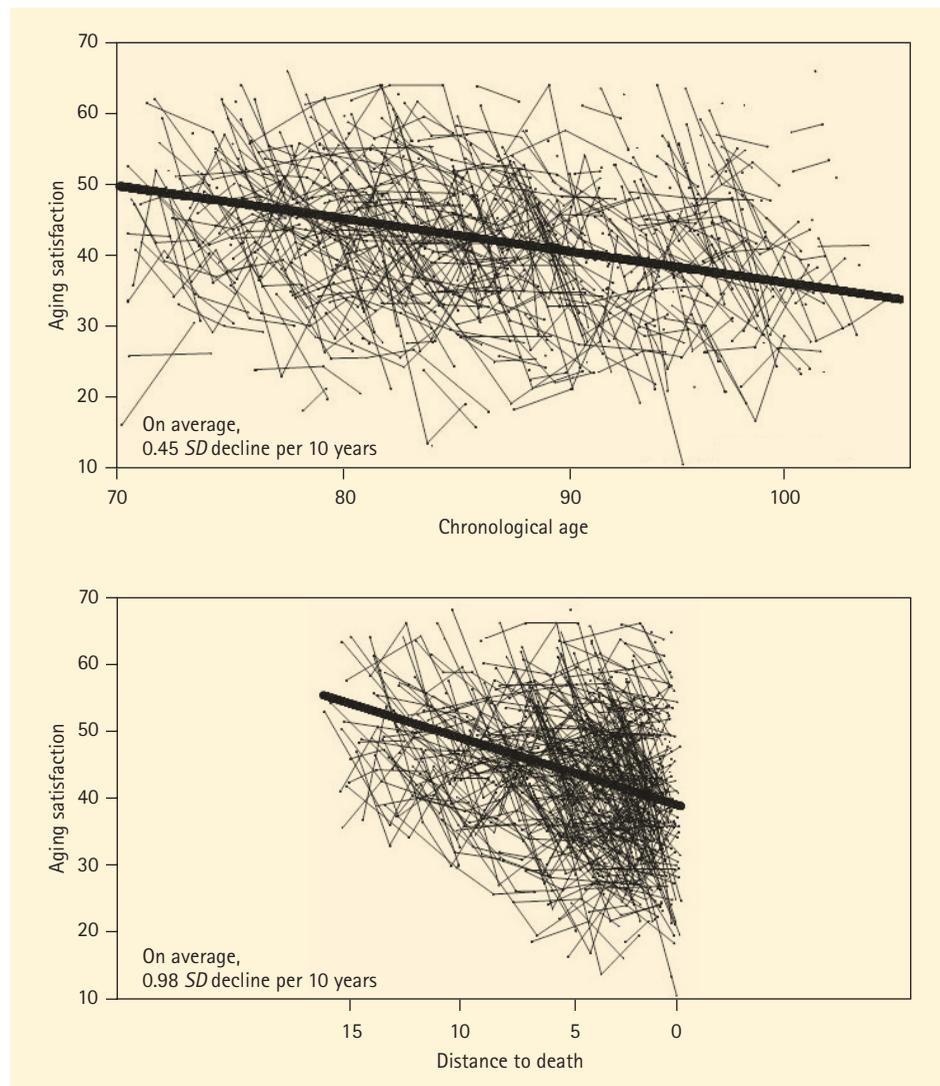


Figure 29. Prototypical (thick line) and raw intraindividual changes (thin lines) observed over age (upper panel) and distance to death (lower panel) in aging satisfaction. The age model shows significant, but relatively minor, average age-associated decline (-0.45 T -score units per year), whereas decline in the distance-to-death model was steeper by a factor of 2 ($-.98$ T -score units per year; adapted from Kotter-Grühn, Kleinspehn-Ammerlahn et al., 2009).

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While validating the need to search for general mechanisms of behavioral senescence, these results confirm that longitudinal sensory-cognitive links are less pronounced than the corresponding cross-sectional observations (see also Lindenberger, von Oertzen, Ghisletta, & Hertzog, in press; Project 7, p. 221). In a new analysis, Ram, Gerstorf, Lindenberger, and Smith (in press) examined how long-term changes in cognitive ability are

related to short-term changes in cognitive performance, cardiovascular function, and emotional experience. They used data from a burst of measurement that was carried out at T7 of BASE-I and observed that less cognitive decline over approximately 13 years was associated with greater cognitive plasticity, less cardiovascular lability, and less emotional diversity over approximately 2 weeks at an average age of 90 years.

In concert, the four BASE-I publications during the reporting period highlight the continuing potential of this longitudinal data set for analysis of individual function and development in very old age, with a particular emphasis on mechanisms operating close to death. In addition, Ana Sofia Morais has begun to analyze individual differences and age-related changes in the organization of semantic knowledge using archival data from a verbal fluency test (e.g., naming as many different animals as possible within 90 s). Finally, reflecting recent genetic analyses of blood samples stored since T1, future analyses in BASE-I will also examine genetic predictors of individual differences in late-life changes across a range of functional domains, including cognition and well-being.

Berlin Aging Study II (BASE-II): Health and Cognition in Adulthood

Health in old age ranges from instances of well-preserved cognitive and bodily functions to states of frailty and morbidity, both within and across individuals. Many factors are associated with differences in health in old age and longevity, including genetics, cognitive abilities, social networks, and vasculature. The mechanisms underlying heterogeneity in old age need to be studied at multiple levels of analysis, from the genome to the physiology of organs, and to the functionality of behavior. With these goals in mind, a group of researchers in Berlin and at the University of Tübingen has initiated the Berlin Aging Study II. The general objective of BASE-II is to identify antecedents of heterogeneity in old age at somatic, behavioral, and social levels of analysis. BASE-II is a collaborative multidis-

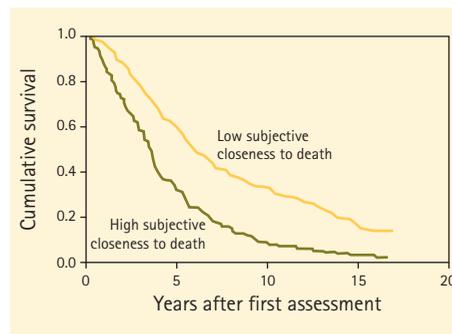


Figure 30. Participants who did not feel close to death at T1 (yellow line) had a higher survival probability over the 16-year assessment period than participants who felt close to death (green line; adapted from Kotter-Grühn, Grühn, & Smith, 2010).

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ciplinary research effort that involves five different research institutions (see pp. 210). The Geriatrics Research Group of the Charité University Medicine coordinates the study; the role of the Center for Lifespan Psychology is restricted to the assessment of cognitive abilities and data management. The BASE-II sample consists of 600 adults aged 20–30 years and 1,600 adults aged 60–70 years, stratified by sex. The sample has been recruited from three large-scale studies previously carried out at the Center for Lifespan Psychology. To facilitate the analysis of sample selectivity, the BASE-II sample has been included in the assessment scheme of the German Socio-Economic Panel Study (SOEP). BASE-II has received financial support from the Federal Ministry of Education and Research (BMBF). Collection of a first wave of data, including in-depth medical exams at the Charité, has begun and is likely to last for another 1 to 2 years.

Key Reference

Ram, N., Gerstorf, D., Lindenberger, U., & Smith, J. (in press). Developmental change and intraindividual variability: Relating cognitive aging to cognitive plasticity, cardiovascular liability, and emotional diversity. *Psychology and Aging*.

Overview of the Berlin Aging Study I (BASE-I)

The multidisciplinary Berlin Aging Study (BASE-I), initially directed by the late Paul B. Baltes and Karl Ulrich Mayer, was started in 1989 under the sponsorship of the former West Berlin Academy of Sciences and Technology and its Committee on Age and Societal Development. Later, the study came under the auspices of the Berlin-Brandenburg Academy of Sciences. The current BASE-I core group is headed by Ulman Lindenberger. As of 2008, the study involves eight measurement occasions spaced over 18 years. In addition, several subsamples have been recruited for intensive study. The distinguishing features of BASE-I 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 (involving two research units from the Free University 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-I (1990–1993) was to obtain a heterogeneous sample, stratified by age and sex, of individuals aged 70 to 100+ years who completed a 14-session Intensive Protocol that involved detailed measures from each of the four participating disciplines. The original sample participating in this initial Intensive Protocol consisted of 258 men and 258 women from the western districts of Berlin. Seven longitudinal follow-ups of the survivors from this initial sample involving different depths of assessment have been completed at approximately 2-yearly intervals. A single-session multidisciplinary assessment was collected 1993–1994 ($N = 359$), reduced versions of the Intensive Protocol (six sessions) were collected in the periods 1995–1996 ($N = 206$) and 1997–1998 ($N = 132$), and a repeat of parts of the Psychology Battery together with multidisciplinary outcome variables (e. g., screening for dementia, assessment of well-being) in 2000 ($N = 82$), 2004 ($N = 46$), 2005 ($N = 37$), and 2008–2009 ($N = 22$; with an additional medical and dental focus). In addition, mortality information about the entire BASE-I sample is updated at regular intervals. The initial sample of 516 individuals formed the basis of the cross-sectional analyses reported in two monographs (in German: Mayer & Baltes, 1996, 1999; cf. Lindenberger, Smith, Mayer, & Baltes, 2010; in English: Baltes & Mayer, 1999, 2000). Current interests of the Psychology Unit of BASE-I include issues of sample selectivity and representativeness; intraindividual variability and change; terminal decline; cognitive aging; mortality prediction; self-related change, well-being, and antecedents of successful aging; and genetic predictors of individual differences in cognitive and self-related change in old age.

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Research Project 6: Interactive Brains, Social Minds

In everyday life, people often need to coordinate their actions with each other. Common examples are walking with someone at a set pace, playing collective sports, dancing, playing music in a duet or group, as well as a wide range of social bonding behaviors, such as gaze coordination between mother and infant or between partners. Despite the undisputed developmental and social significance of these interpersonally coordinated behaviors, little, if anything, is known about their real-time dynamics and about the brain mechanisms that support them. The Interactive Brains, Social Minds project investigates lifespan changes in behavioral and neuronal mechanisms that permit individuals to coordinate their behavior with each other in time and space (see Figure 31). The project is structured into two parts, one focusing on infant development and the other on other parts of the lifespan.

The Interactive Brains BabyLab

From early on, infants learn from their conspecifics and perceive them as social partners. The research focus of the BabyLab is on behavioral and physiological online indicators of social interaction processes, such as timing characteristics and action simulation, as well

as on perceptual and cognitive mechanisms related to these processes, such as memory and multisensory integration. In a first study, we investigated how learning is influenced by the degree of joint attention. Four- and nine-month-old infants interacted with a female adult while they were

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Key Reference

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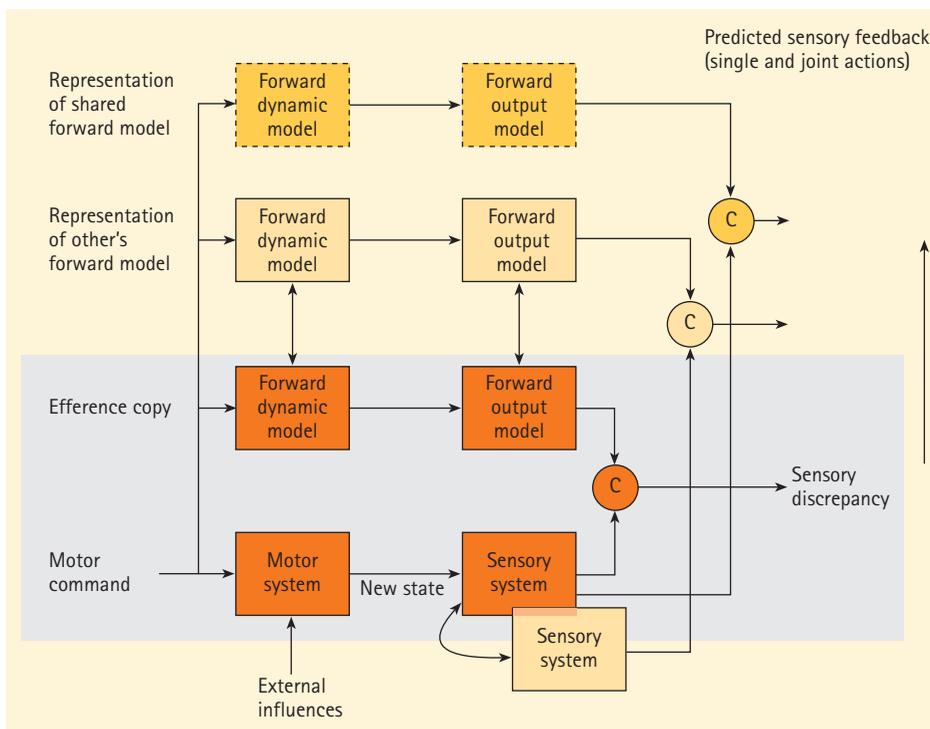


Figure 31. A forward model of interpersonal action coordination. Drawing on the work of Steven M. Boker, Wolfgang Prinz, Daniel Wolpert, and others, our model assumes that interpersonal action coordination is based on a set of linked representational layers. The single-person layer is shaded in gray. Individuals acting together attempt to synchronize their forward model regarding their own actions with their forward model regarding the other person's actions. Highly skilled individuals, such as dancers or musicians, may represent jointly performed activities as a unified suprapersonal action with a joint forward model and partially joint sensory feedbacks. The various representational layers of the actors are intertwined by sensorimotor feedback loops.

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familiarized with objects. Event-related brain potentials (ERPs) were assessed to previously learned and to novel objects both immediately after familiarization and again after 1 week.

Results for 9-month-old infants suggest that neural mechanisms of novelty and of joint attention are dissociable on the basis of ERPs (Figure 32; see Kopp & Lindenberger, in press).

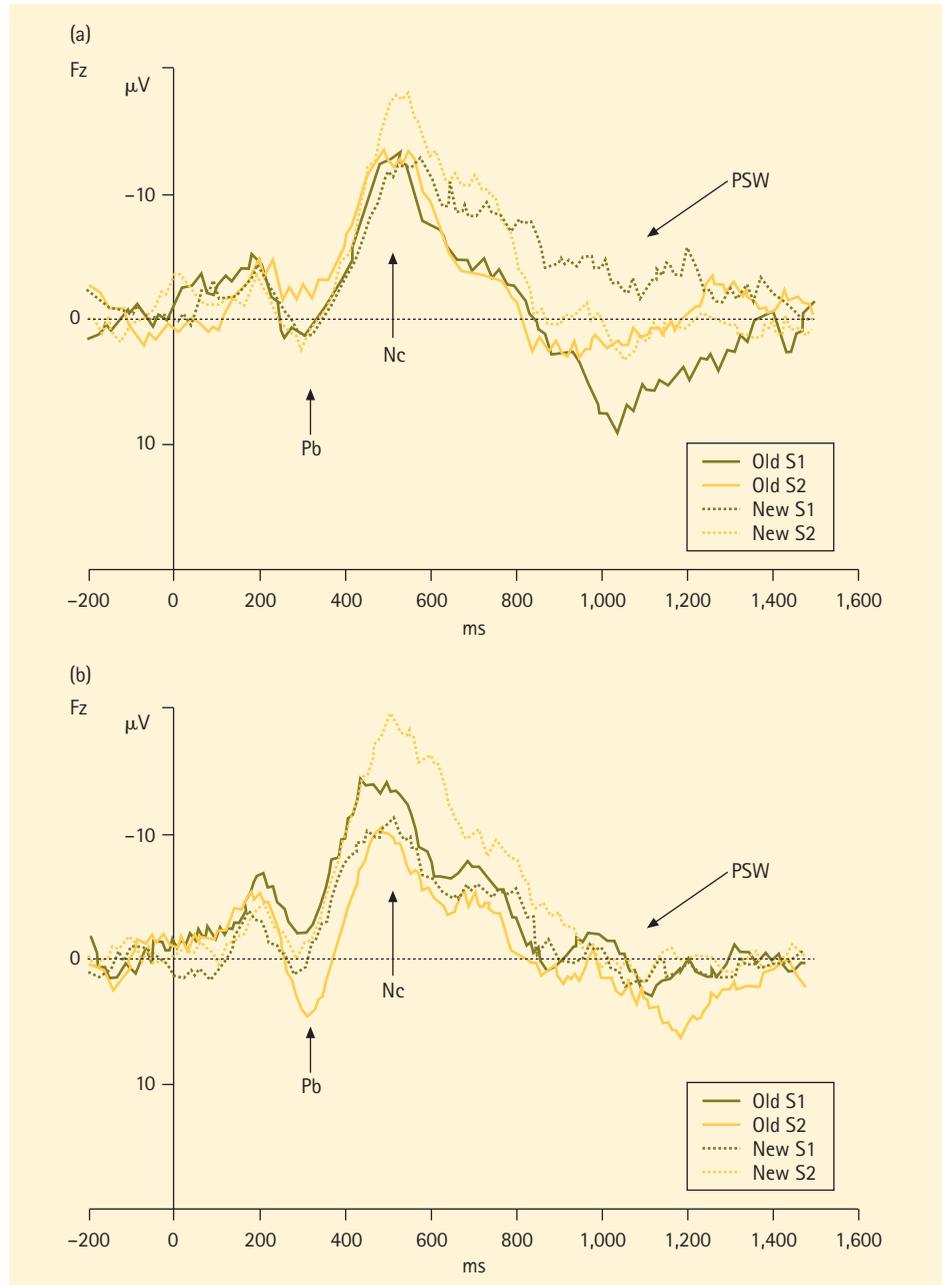


Figure 32. Joint attention and long-term retention in infancy. Event-related potentials of 9-month-old infants at electrode Fz. Children were familiarized with objects under conditions of (a) high joint attention (HI-JA) and (b) low joint attention (LO-JA). Recognition of learned (old) and new objects was probed immediately (S1) and after a 1-week delay (S2). Nc was found to be sensitive to novelty under both attention conditions. PSW and Pb were modulated by joint attention in immediate and delayed recognition, respectively (adapted from Kopp & Lindenberger, in press).

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The amplitude of infants' Nc ERP component was modulated by stimulus novelty. In addition, the positive slow wave (PSW) as an indicator for memory updating and Pb as an indicator for stimulus expectancy were related to short- and long-term effects of joint attention, respectively. Furthermore, PSW activity was modulated by infant gazing behavior during familiarization. Importantly, this study revealed that joint attention at initial encoding affects long-term retention of objects in 9-month-old infants. Moreover, analyses that are currently underway suggest that joint-attention effects on ERP indicators of long-term retention can also be identified in 4-month-old infants.

In her dissertation project, Karen Bartling investigated the development of infants' sensitivity to social contingency and the relation to individual differences in maternal affect attunement (MAA). An initial study served to document the reliability of the MAA coding scheme (Bartling, Kopp, & Lindenberger, 2010). At two measurement occasions, 5- and 7-month-old infants interacted with their mothers by means of a double-screen setup (Figure 33), with the mothers' audiovisual presentation being either (a) live (high contingency), (b) temporally delayed by one second (moderate contingency), or (c) replayed from session one (low contingency). Behavioral and heart-rate measures revealed that infants in both age groups were able to distinguish be-

tween live and replayed maternal responses. In contrast, differences in response to live versus delayed sequences were manifest at both behavioral and physiological levels among the older infants, but restricted to the physiological level in the younger infants. Further analyses will include the relation of behavioral and heart-rate changes with individual differences in MAA.

A related line of research investigates mechanisms of action prediction and action simulation in infants (Dissertation Cathleen Bache). To identify such mechanisms, 10-month-old infants are observed while watching a video of another infant crawling. Occluding frames interrupt the observable motion, and behavioral, electroencephalogram (EEG), and eye-tracking data are taken. Finally, in exchange with the other subproject (see below), we also study infants' ability to temporally integrate auditory and visual information. In an EEG experiment, 6-month-old infants watched a person clapping her hands rhythmically with the auditory and visual streams either being in synchrony or the visual stream being delayed in time. In preliminary analyses, we identified ERP components that differentially relate to the perception of audiovisual synchrony and asynchrony, respectively. In future work, we will examine the role of audiovisual temporal integration in live social interactions of 3- and 5-month-old infants with their mothers.

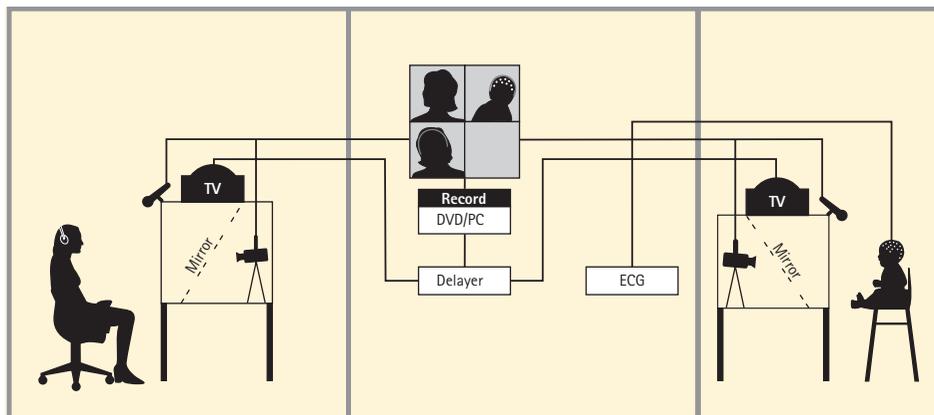


Figure 33. The double-screen setup used to study infants' sensitivity to social contingency and audiovisual temporal integration. The setup allows manipulating the timing of audiovisual responses of one or both interaction partners.

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The Interactive Brains LifespanLab

During the reporting period, the project continued to explore experimental paradigms that may be suitable for the study of behavioral and neuronal mechanisms of interpersonal action coordination. Three such paradigms appeared to be particularly promising and will form the basis for further inquiry. The first paradigm consists of pairs of expert guitarists whose EEGs are being recorded while they are playing the same short tune in unison for a large number of trials (Figure 34; Lindenberger, Li, Gruber, & Mueller, 2009). By applying synchronization algorithms to intra- and interbrain analyses, we found that phase synchronization both within and between brains increased significantly during the periods of preparatory metronome tempo setting and coordinated play onset (Figure 35). In addition, phase alignment extracted from within-brain dynamics was related to behavioral play onset asynchrony between guitarists. Our results show that interpersonally coordinated actions are preceded and accompanied by between-brain oscillatory couplings. Presumably, these couplings reflect similarities in the temporal properties of the individuals' percepts and actions. We are currently applying directional coupling measures to this data set and will further refine and expand the experimental paradigm to examine more closely whether between-brain oscillatory couplings play

a causal role in initiating and maintaining interpersonal action coordination. Following the conceptual schema shown in Figure 31, we also will use high-speed video cameras to capture between-person perceptual feedback with sufficiently high temporal resolution. In subsequent experiments (Dissertation Johanna Sanger), we alternated the role of leader and follower in duet playing. Specifically, simultaneous EEG, electrocardiogram (ECG), respiratory activity, and hand movements were recorded in duets of experienced guitarists while playing a short musical piece for two guitars (Rondo by C. G. Scheidler) or while improvising. Directed effects at different levels of analyses are expected to reflect the asymmetry between leader and follower. Synchronization as well as connectivity are expected to be most prominent at points in time where guidance and coordination are especially needful, such as play onsets and tempo changes. In addition to the Phase-Locking Index (PLI) and Interbrain Phase Coherence (IPC) as measures of intra- and interbrain coherence measures, Granger causality and unified structural equation modeling will be applied to account for directed effects between the two brains.

The third series of studies aimed at identifying mechanisms of interpersonal action coordination are behavioral and physiological assessments during choir singing with and without a conductor. Using simultaneous ECG and

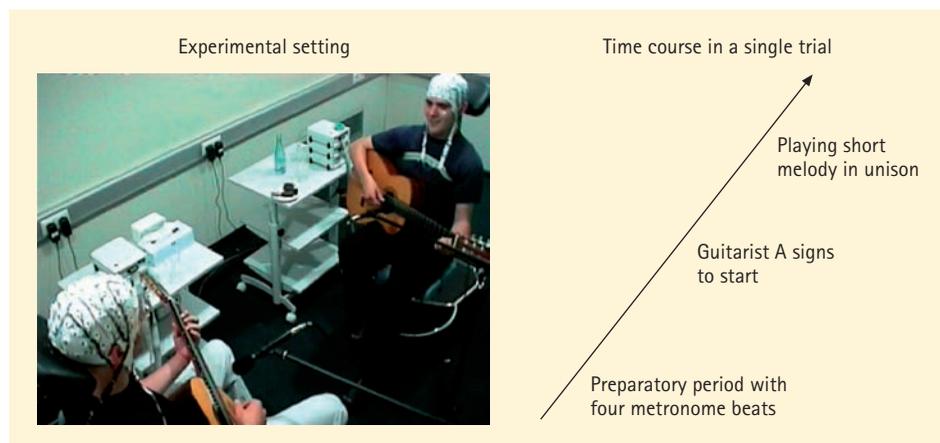


Figure 34. Time course and experimental setup with a pair of guitarists.

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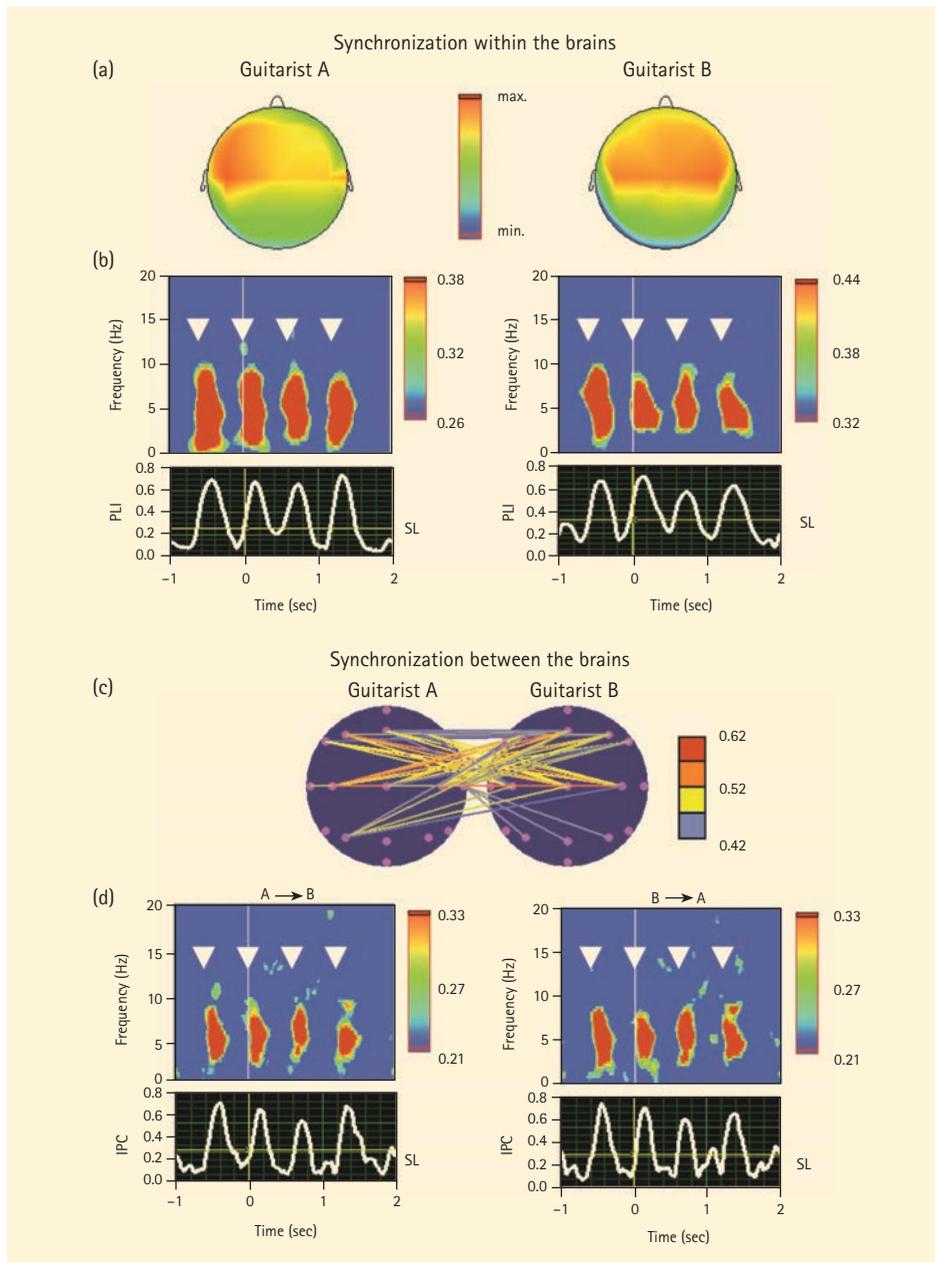


Figure 35. Phase synchronization within and between brains during the preparatory period of metronome tempo setting. (a) Topological distributions of the Phase-Locking Index (PLI) in a representative pair of guitarists, A and B, at the theta frequency (4.95 Hz) 140 ms after stimulus onset (second metronome beat). Fronto-central maxima of PLI are shown. (b) Time-frequency diagrams of average PLI for guitarists A and B separately. PLI was averaged across six fronto-central electrodes. Only significant PLI values ($p < 0.01$) are highlighted. Time zero is time locked to the second metronome beat. Metronome beats are shown by white arrows. The time course of PLI values at the theta frequency (4.95 Hz) is depicted below the time-frequency diagram. (c) Interbrain synchronization between the two guitarists measured by Interbrain Phase Coherence (IPC) at the theta frequency (4.95 Hz) 140 ms after stimulus onset. Colored lines indicate synchrony between electrode pairs of the two guitarists, corresponding to significant interbrain synchronization. Only IPC values higher than 0.41 are highlighted. (d) Time-frequency diagram of the average IPC averaged across six electrode pairs. In the left diagram (A → B), the selected electrode pairs represent phase coherence between one electrode of guitarist A (Cz) to the six fronto-central electrodes of guitarist B. Conversely, the right diagram (B → A) refers to one electrode of guitarist B and the six fronto-central electrodes of guitarist A. Only significant IPC values ($p < 0.01$) are highlighted. The time course of IPC values at the theta frequency (4.95 Hz) is depicted below the time-frequency diagram. SL = significance level (adapted from Lindenberger, Li, Gruber, & Mueller, 2009).

respiration measures, we investigate synchronization mechanisms during singing in unison and in different voices. Preliminary analyses suggest that phase synchronization for respiration and heart-rate variability increase significantly during singing relative to rest and are higher during singing in unison than during polyphonic singing. Coupling measures indicate strong directed effects from conductor to choir at a high modulation frequency. During the reporting period, members of the project also investigated age-graded differ-

ences in ERP and EEG components across the lifespan using standard single-person experimental paradigms, such as auditory discrimination (Mueller, Gruber, Klimesch, & Lindenberger, 2009). Though this line of work does not speak directly to the issue of neuronal mechanisms supporting interpersonal action coordination, the resulting knowledge about age-graded differences in cortical dynamics will aid the design and interpretation of age-comparative studies on cortical correlates of joint action that are in the planning stage.

Research Project 7: 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 Formal Methods project continues this tradition, with an emphasis on computer algebra and machine learning. Its main goals are to critically examine the link between theory and data provided by existing statistical methods and equip researchers with means to optimize the efficiency of data acquisition and data analysis. The project uses the generality of Structural Equation Models (SEMs) to represent both methods and study designs, and statistical power as a metric to compare design features. In the reporting period, we primarily focused on efficient study designs using power equivalence and the analysis of psychological time series.

Efficient Study Designs Using Power Equivalence

Research on individual development often requires longitudinal studies with relatively large numbers of individuals, variables, and measurement occasions. Designing and implementing such studies is costly. Researchers generally harbor some conception of possible trade-offs among the research design parameters, but lack a metric to formally relate these parameters to each other and gauge their relative importance and potential trade-offs. For example, for a given study, it is difficult to know without formal analysis whether the loss of one occasion of measurement is offset by the addition of 50 participants.

Statistical power, that is, the probability that a statistical test will reject a false null hypothesis, provides a metric for comparing the various design features of empirical studies. Comparing models using this metric is the target of power equivalence theory, developed by Timo von Oertzen during the reporting period (von Oertzen, 2010). Power equivalence relates different SEMs to each other and designates them as power equivalent if their statistical power to detect a given effect is identical. It follows that a given study design represented by an SEM can be transformed into a large number of other study designs that possess the identical power to detect an effect of interest and, hence, are power-

Researchers

Timo von Oertzen
Manuel Voelkle (as of 02/2009)
Ulman Lindenberger

Andreas Brandmaier
(predoctoral fellow)

Key Reference

Oertzen, T. von. (2010). Power equivalence in structural equation modeling. *British Journal of Mathematical and Statistical Psychology*, 63, 257–272. doi: 10.1348/000711009X441021

Table 2
Costs for Alternative Study Designs With Identical Statistical Power to Detect Interindividual Differences in Change ($N = 100$ Participants, Effect Size 0.07% of Intercept Variance, Reliability 90% at First Occasion)

Observations	Weeks	Costs of measurements (\$)	Running costs (\$)	Total costs (\$)
11	10.00	220,000	20,000	240,000
10	10.38	200,000	20,766	220,766
9	10.81	180,000	21,621	201,621
8	11.29	160,000	22,582	182,582
7	11.83	140,000	23,670	163,670
6	12.45	120,000	24,904	144,904
5	13.15	100,000	26,299	126,299
4	13.91	80,000	27,826	107,826
3	14.63	60,000	29,262	89,262

equivalent in relation to this effect. Some of these alternative power-equivalent designs may come with lower costs than the originally envisioned design. Thus, power-equivalence theory can be of great practical importance in the planning phase of longitudinal panel studies.

For example, consider a researcher who plans to investigate the effect of a training program on reading skills as modeled by a linear Latent Growth Curve Model (LGCM). He or she wishes to identify and study the correlates of between-person differences in skill acquisition; accordingly, he or she needs a study design that is likely to reliably detect variance in change. Based on extrapolations from earlier work, he or she assumes that the power to reliably detect variance in change would be

95% using one pretest and 10 follow-up tests at each consecutive week. However, using power-equivalent transformations, it can be shown that identical power can be achieved with other combinations of measurement occasions and total exposure time to the training program. For instance, with only four observations equally spread over 14 weeks, the same power is attained with a significantly less demanding procedure. Assuming some possible costs per measurement and per week of the training program, Table 2 compares alternative study designs that are identical in power to the original design, but markedly differ in cost.

Together with Paolo Ghisletta, University of Geneva and Distance Learning University Switzerland, and Christopher Hertzog,

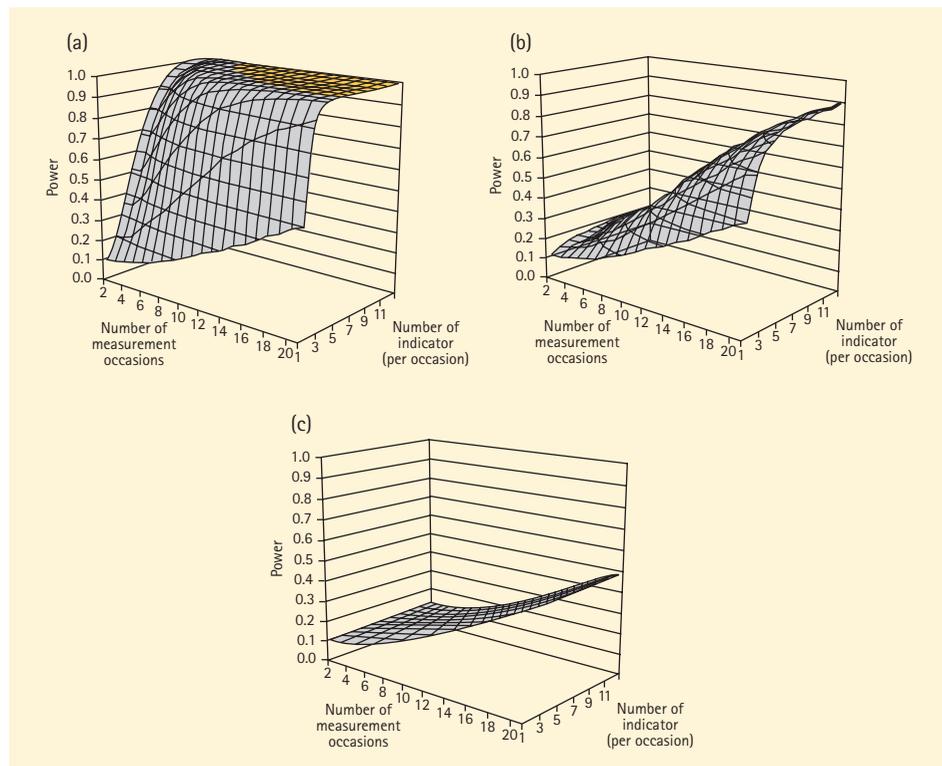


Figure 36. Power to detect variance of slope in an LGCM plotted against number of indicators per occasion and number of measurement occasions in a fixed time span. Power values are given for $N = 200$ participants, intercept variance = 100, slope variance (effect size) = 50, no intercept-slope covariance, and total residual variance of 80. Panel (a) shows the power for a measurement error of 80 and no latent residual. In Panel (b), the indicators have no measurement error, but the residual of the latent construct is 80. Panel (c) is the intermediate case with a measurement error of 40 and a latent residual of 40. The benefit of multiple indicators is especially pronounced when the relative contribution of measurement error to total residual variance is high (adapted from von Oertzen, Lindenberger, & Ghisletta, 2010).

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Georgia Institute of Technology, we applied power equivalence to investigate the effect of multiple indicators on assessing individual differences in change (von Oertzen, Hertzog, Lindenberger, & Ghisletta, 2010). We showed that: (a) multiple indicators help to reduce the effect of measurement error, but not of the latent residual variance common to all indicators; (b) the incorporation of multiple indicators in a longitudinal design allows reduction of the number of longitudinal measurement occasions. Our results imply that the advantage of multiple indicators is strongly dependent on the partitioning of the total residual variance into measurement error induced by an error of measurement itself and the latent residual, representing the imperfection of the model's approximation to reality. Figure 36 gives the statistical power of a longitudinal design for different numbers of measurement occasions and numbers of indicators. In Panel (a), the total residual for each indicator consists of measurement error only. Panel (b) shows the same situation with the same total residual, equally partitioned between measurement error and latent residual. In Panel (c), measurement error is assumed to be absent, so the total residual variance only consists of latent residual variance. A different application of power equivalence is to reduce an SEM to a computationally simpler model while maintaining power. In this vein, power equivalence can be used as a preprocessing tool to increase the speed of power computation and data analysis. Applying this technique to a simulation engine built in earlier work by Paolo Ghisletta and ourselves, the efficiency of power simulations has been increased by a factor of 50. It can be shown that analogous techniques can be applied to speed up data analysis for a subset of SEMs by approximately the same factor. At the same time, estimates become more precise and more robust against poor starting values in the estimation process (cf. von Oertzen, Ghisletta, & Lindenberger, 2010).

Analysis of Time-Series Data

When analyzing stationary time series of psychological data, dynamic properties of the series can be captured using time-delay embed-

ding, that is, by using small samples from the time series. Intuitively, one might assume that optimal control over the measurement error is achieved if the embedded samples contribute independent information and, in particular, are not overlapping. However, together with Steven M. Boker, University of Virginia, Timo von Oertzen showed analytically that the sign of the displacement of a parameter estimate due to a measurement error in one data point depends on the location of the error in the sample (von Oertzen & Boker, 2010). Therefore, if a single data point occurs at different positions in different samples, a measurement error in this data point may result in displacements of the parameter estimates that cancel each other out. It follows that overlapping time-delay embedding allows more precise estimates of dynamical parameters in stationary time series with less data points, compared to independent time-delay embedding. To illustrate this finding, consider the three overlapping local samples from a sine curve indicated by the curly brackets in Figure 37. If a small deviation from the ideal curve is introduced at the middle of the curve, the corresponding data point is changed in all three samples (see Panels a, b, and c). In Panel (a), the divergent data point is at the end of the observed sample. As illustrated, the estimate of the frequency will be reduced due to this deviation. In Panel (b), in which the deviation is in the middle of the sample, the estimate of the frequency will not be impaired. In Panel (c), the deviation at the beginning of the sample will lead to an increased frequency estimate. If the information from all three samples is combined, the effects of the deviation in our example will cancel each other out. Although the cancellation of measurement errors at other positions than the inflection point will be less than perfect, time-delay embedding with overlapping samples will always increase the precision of the frequency estimate relative to time-delay embedding with nonoverlapping samples.

Approaches to the analysis of stationary time series, such as time-delay embedding, benefit from simplicity and efficiency. However, violations of the stationary assumption, as for example time-correlated measurement errors,

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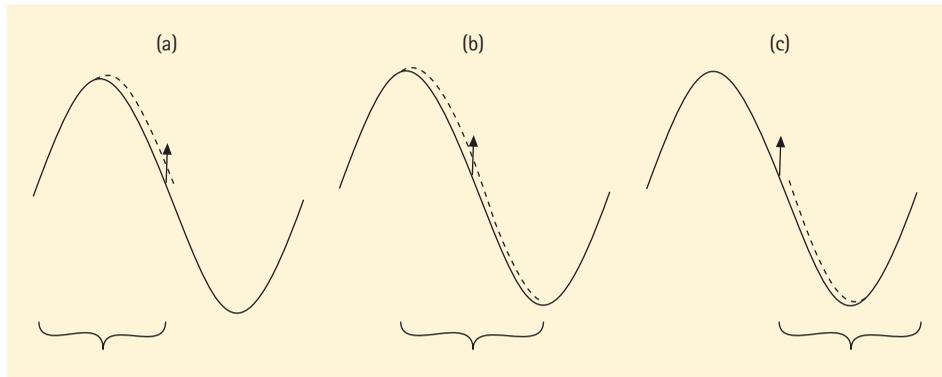


Figure 37. Change of estimated frequency with unknown phase. When a positive error at the end of a sample (with a half cycle and phase zero) is introduced to a perfect data set, the frequency estimate decreases. If the positive error is introduced in the middle of a sample with phases $\pi / 2$, the estimate of the frequency does not change; if the error is introduced at the beginning of a sample with phases π , the frequency estimate increases. Thus, in a time-delay embedding, a small error introduced to a perfect data set cancels out. If the error is introduced at a phase that is an integer multiple of $\pi / 2$ and the estimate is made for each sample separately and then averaged, the canceling is perfect. Curly brackets indicate the observed time span (adapted from von Oertzen & Boker, 2010).

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are difficult to model with these approaches. Taking advantage of the full flexibility of SEM, Manuel Voelkle investigated the possibility to model autoregressive models of many observations directly with SEM. With SEMs, time-dependent measurement error or correlations of measurement errors and changes in the autoregression parameters over time can be estimated. Moreover, it is possible to accommodate differences in time intervals within and between studies by modeling autoregressive parameters in continuous time. Together with Paolo Ghisletta, Christopher Hertzog, and John J. McArdle, University of Southern California, we also continued to explore the statistical power of dynamic coupling parameters in the dual-change score model introduced by John J. McArdle and Fumiaki Hamagami in the 1990s. The bivariate dual-change score model combines the benefits of latent growth curves and cross-lagged regressions, as the change in one variable over time is dependent both on its own and the other variable's value at the previous time point. To comprehensively examine the power to detect the cross-coupling parameters as a function of different parameters, such as number of occasions, sample size, and reliability, we extended the project's simulation engine to encompass the simulation of

dual-change score models as a special case. Ongoing work suggests that the power to detect cross-coupling parameters is influenced by the reliability of the variables and by sample attrition.

In data sets of time series from multiple participants, the dynamics of all time series is sometimes not well described by a single parameter fit to a model like a regression model or a dynamical SEM with time-delay embedding. Instead, different participants may follow different dynamical patterns, possibly indicated by collected covariates. To identify such partitioning of the data set, Andreas Brandmaier has introduced the notion of "SEM-Trees" in his dissertation thesis, which will be completed in 2011. In this approach, the covariate splits the data set into two subsets that differ most in SEM parameters, as indicated by the difference to the fit of the combined model. Each subset is subsequently split in the same way until no further split is found that results in reliable improvements in fit, defined on the basis of a likelihood ratio test with a specified alpha level. Put in more general terms, SEM-Trees combine the benefits of exploratory and confirmatory methods. Longitudinal SEM-Trees may allow researchers to discover antecedents of individual differences in change.

In his dissertation, Andreas Brandmaier has also been exploring the use of a clustering algorithm for time series based on the permutation distribution in research with behavioral and physiological time-series data. Clustering methods often show dependency on drifts in measurement or on scaling due to the distance function, which usually uses moments of the time-series' distribution. In contrast, the permutation distribution relies on ordinal information only; hence, it is unaffected by monotonous scaling transformations. First results suggest that the permutation distribution clustering method is applicable to a wide range of time-ordered data including electroencephalograms (EEG), heart rate, breathing, and movement.

From a time-series perspective, cross-sectional studies represent an extreme case of missing data. Nevertheless, cross-sectional designs continue to be used extensively in research on aging for testing causal hypotheses about change. A commonly used statistical method is cross-sectional age-variance

extraction, in which age, the indicator of a hypothesized developmental mechanism, and a developmental outcome are specified as independent, mediator, and target variables, respectively. Building on earlier work by Christopher Hertzog, Scott Hofer, Karl Theo Kalveram, Ulman Lindenberger, Ulrich Pötter, Martin Sliwinski, and others, we formally showed that longitudinal change in a mediator variable accounting for substantial cross-sectional age-related variance in the target variable need not correlate with the target variable's longitudinal change, and, conversely, that longitudinal change in a mediator not sharing cross-sectional age-related variance with the target variable may nevertheless correlate highly with that variable's longitudinal change (Lindenberger, von Oertzen, Ghisletta, & Hertzog, in press). Based on these and related results, we discourage the use of cross-sectional age-variance extraction for testing multivariate hypotheses about behavioral development.

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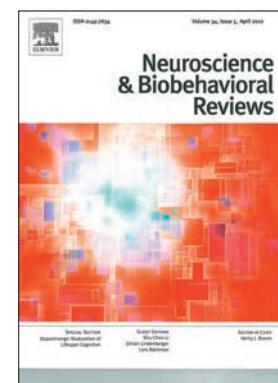
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Max Planck Research Group

Neurocognition of Decision
Making

Max Planck Research Group

The Institute has housed the **Max Planck Research Group "Neurocognition of Decision Making"** until September 2010 (Head: Hauke R. Heekeren). Using a combination of psychophysical methods, functional and structural neuroimaging, modeling, and pharmacological intervention, this group investigated mechanisms of decision making in the human brain.



Research Staff 2009–2010

Hauke R. Heekeren (as of February 2009: also Free University Berlin)

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Research Agenda: Multimodal Approach to the Neurocognition of Decision Making

Decision making can be defined as the process of choosing a preferred option or course of action from among a set of alternatives. There is a long history of decision-making research in psychology and economics that has resulted in the development of formal models of behavior, which are inspired by behavioral data or the computational demands of a task. Examples for the former are sequential sampling models of decision making. Examples for the latter are reinforcement learning models for repeated choice tasks. Cognitive functions, such as decision making, can, however, not be completely understood on the basis of mathematical models and behavioral data alone; we have to investigate how mental (cognitive) and neuronal processes map onto each other. Therefore, a central goal of the Max Planck Research Group "Neurocognition of Decision Making" is to explicitly link brain function and behavior using formal models of decision-making behavior.

In pursuit of this goal, we investigate decision making in different domains. First, at the basis of a number of different decisions we are facing in everyday life stands *perceptual decision making*: the process of translating sensory input into some kind of motor output (cf. Figure 1). Second, many of our decisions are influenced by the potential outcomes associated with different options; hence,

reward-based decision making is another important topic for our group. Finally, *decision making in social contexts* relies not only on perceptual and reward-related processes but also includes more complex cognitive processes and emotional aspects as well as the interaction between the two. We believe that the investigation of the neurocognition of decision making requires a multimodal meth-

Key Reference

Raab, M., Johnson, J. G., & Heekeren, H. R. (Eds.). (2009). *Mind and motion: The bidirectional link between thought and action* (Progress in Brain Research No. 174). Amsterdam: Elsevier.

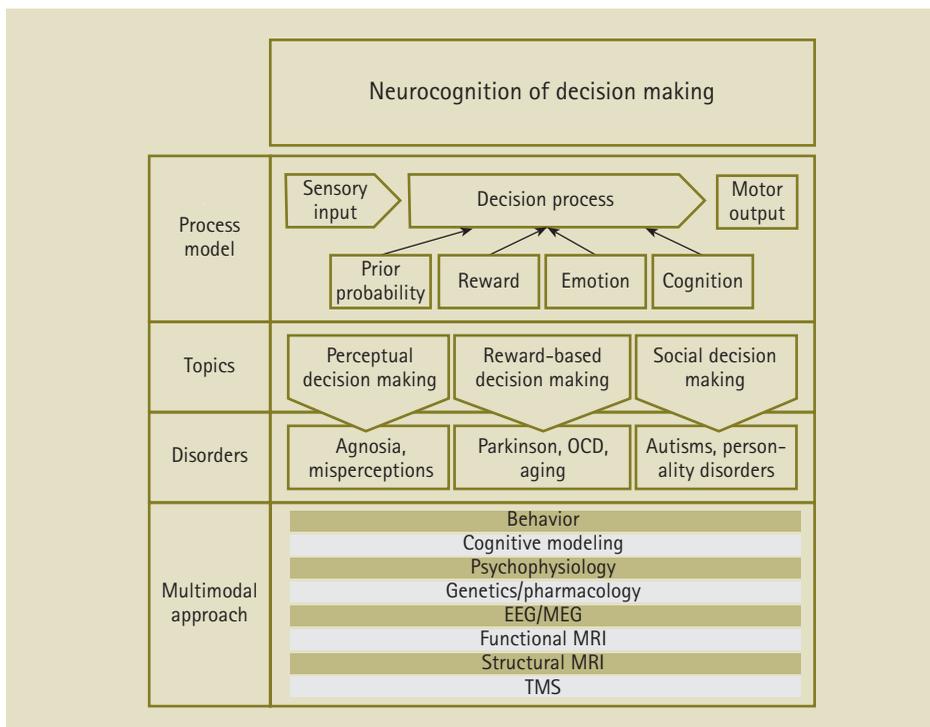


Figure 1. Multimodal approach to neurocognition of decision making.

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Key Reference

Heekeren, H. R., Marrett, S., & Ungerleider, L. G. (2008). The neural systems that mediate human perceptual decision making. *Nature Reviews Neuroscience*, 9, 467–479.

odological approach that integrates information from an array of methods, ranging from cognitive modeling based on behavioral data to fMRI and MEG experiments (cf. Figure 1). On the following pages, we briefly describe research in the three topics in more detail. Each section begins with a brief introduction, which is followed by short descriptions of individual projects.

Neurocognition of Perceptual Decision Making

Perceptual decision making is the act of choosing one option or course of action from a set of alternatives based on the available sensory evidence (Heekeren, Marrett, &

Ungerleider, 2008). Thus, when we make decisions, sensory information must be interpreted and translated into behavior. For example, in a motion-direction discrimination task, motion signals need to be interpreted and translated into a saccadic eye movement. In a face-house discrimination task, degraded images of faces and houses have to be interpreted and translated into a button press with the right or the left hand (see Figure 2). Decision-making research has resulted in mathematical models of the assumed underlying cognitive processes. Sequential sampling models are particularly successful in explaining response time data and accuracy in two-choice reaction time tasks, such as the ones described

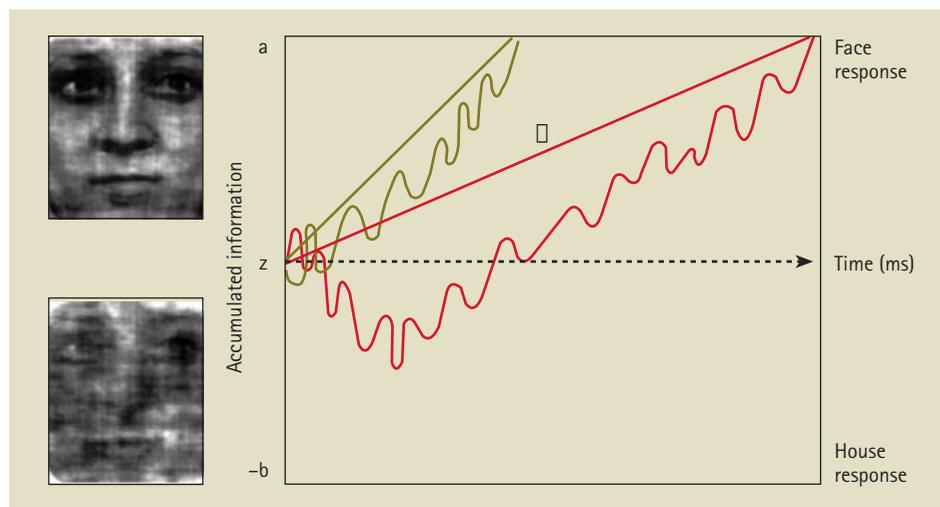


Figure 2. Decision-making research has led to the development of mathematical models of the assumed underlying cognitive processes. Diffusion models are particularly successful in explaining response time and accuracy data in two-choice reaction-time tasks. These models assume that decisions are formed by continuously accumulating sensory information until one of the two response criteria (a or -b) is reached (see figure). Once a boundary has been reached, the decision process is concluded and a response is elicited. Moment-by-moment fluctuations in the sample path reflect noise in the decision process. The drift rate (μ) is related to the efficacy of information processing and depends on the strength of the sensory signal and on the accumulation rate (i.e., the increase in the decision variable that quantifies how much evidence is accumulated per time interval). Clear images of faces contain more sensory evidence than degraded images, and, therefore, the drift rate is greater for clear images (green trace in the figure) than for degraded images (red trace). Recent studies have also modeled neurophysiological data as a diffusion process: a dual-diffusion model provides a quantitative account of both the behavior in simple perceptual decision making and the patterns of activity in competing neuron populations. In these studies, monkeys performed a brightness-discrimination task and made saccades to one of two peripheral targets. Task difficulty was manipulated by varying the ratio of black to white pixels. A diffusion model was fitted to the behavioral data. Based on the hypothesis that the neuronal firing rate is linearly related to the accumulated evidence, simulated paths from the model were compared with neural activity. Similar to the behavioral data, the firing rate data showed delayed availability of discriminative information for fast, intermediate, and slow decisions when activity was aligned on the stimulus. By contrast, the firing rate showed very small differences in discriminative information when activity was aligned on the saccade. The first study to link human brain signals with parameters of the diffusion model was that of Philiastides and Sajda (2007). These authors estimated diffusion rates for different noise levels on the basis of behavioral data from a face-car categorization task.

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above. A prominent version of sequential sampling models are diffusion models, which assume that decisions are formed by continuously accumulating sensory information until one of the two response criteria (a or -b) is reached (cf. Figure 2). Once a boundary is reached, the decision process is concluded and a response is elicited. Moment-by-moment fluctuations in the sample path reflect noise in the decision process. The drift rate (μ) is related to the efficacy of information processing and depends on the strength of the sensory signal as well as the accumulation rate (the increase in the decision variable that quantifies how much evidence is accumulated per time interval). Clear images of faces contain more sensory evidence than degraded images, therefore, the drift rate is greater for clear images (green) than for degraded images (red) (see Figure 2).

More recent studies in monkeys and humans have begun to model not only psychophysical but also neurophysiological data as a diffusion-to-barrier process providing a quantitative link between behavior (decision outcome) and neural activity (decision processing) (Heekeren et al., 2008). In ongoing projects, we build on our previous work and provide causal evidence for a role of the dorsolateral prefrontal cortex (DLPFC) in perceptual decision making, try to disentangle motor preparation and decision-related processing, and test how task instructions and reward information modulate perceptual decision making. Finally, we investigated, how human decision makers adapt thresholds to maximize reward in a perceptual decision-making task.

A Causal Role for the DLPFC in Perceptual Decision Making

The way we interpret and interact with the world entails making decisions on the basis of available sensory evidence. As highlighted above, perceptual decisions are often thought to involve an integrative process in which sensory evidence accumulates over time until an internal decision bound is reached. Based on previous reports, one possible region that might be involved in this integrative process is the DLPFC (cf. Heekeren et al., 2008). Despite

the importance of this finding in advancing our understanding of the neural correlates of perceptual decision making, human studies have not yet provided causal evidence linking these candidate areas directly to the mechanism of evidence accumulation.

The major limiting factor in establishing this link has been the correlational nature of most neuroimaging methods, which provide no causal (i.e., interventional) evidence for the functional contribution of activated brain regions to a particular task or underlying neuronal process. In this project, we combined rTMS and computational modeling to help establish the missing causal link between prefrontal cortex and the process of evidence accumulation during human perceptual decision making.

Specifically, we used a speeded perceptual categorization task designed to induce a time-dependent accumulation of sensory evidence through rapidly updating dynamic stimuli after having disrupted the func-

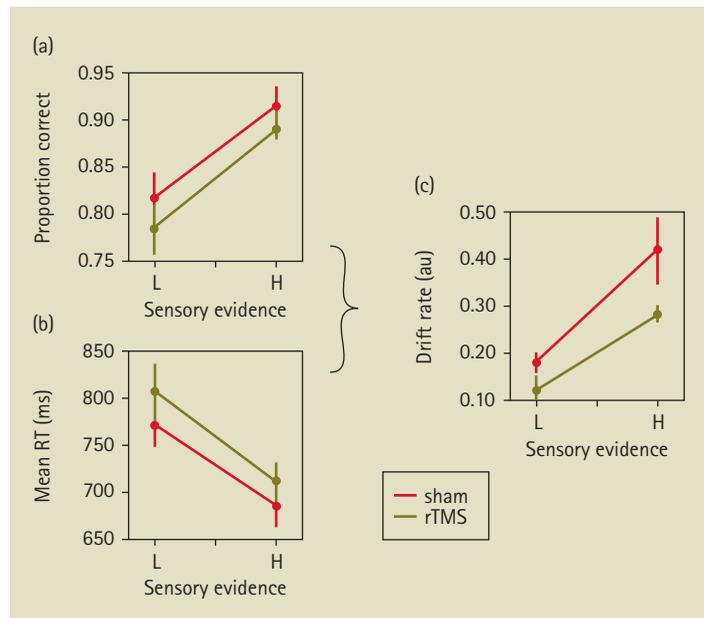


Figure 3. Behavioral performance during the rTMS (green) and sham (red) conditions. (a) Mean accuracy and (b) mean response time (RT) across participants for two levels of sensory evidence (L: low, H: high). Disruption of left DLPFC with rTMS reduced accuracy and increased RTs relative to the sham condition. (c) Modeling this behavioral performance with the diffusion model revealed that the effects were due to a reduction in the rate of sensory evidence integration during rTMS of left DLPFC. Error bars represent standard error of the mean.

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tion of left DLPFC with rTMS. We found that disruption of left DLPFC with rTMS reduced accuracy and increased response times relative to a sham condition (cf. Figure 3a, 3b). Importantly, using the drift diffusion model, we showed that these behavioral effects correspond to a decrease in drift rate, the parameter describing the rate, and thereby the efficiency of the sensory evidence integration in the decision process (cf. Figure 3c). These results provide causal evidence linking DLPFC to the mechanism of evidence accumulation during perceptual decision making.

Disentangling Perceptual Decision Making and Motor Preparation

It has been claimed that sensorimotor areas involved in planning a response, such as an eye movement or a button press, also participate in decision making. For instance, the LIP of the macaque, which is involved in planning eye movements, also shows a response profile compatible with integration of sensory evidence leading to a perceptual decision. Specifically, LIP neurons fire more strongly, and show a greater build-up of activity, during viewing of a stimulus that contains more sensory evidence (less noise) compared to a stimulus with less sensory evidence (more noise).

However, perceptual decisions (deciding if a visual image is a face or house, or if a field of dots is moving right or left) should, in principle, be possible without having to produce a motor response. In fact, more often than not, we make perceptual decisions without having to produce a button press or an eye movement to indicate that decision. Previous fMRI and single-unit recording studies have (with very few exceptions) always paired preassigned motor responses with perceptual decisions and thus may have confounded representation of sensory evidence with processes related to motor preparation. For instance, rightward dot motion was paired with a rightward saccade and leftward motion with a leftward saccade; the motor targets were thus already known at the time of the perceptual decision. This suggests that the perceptual decision might have automatically triggered preparatory motor activations

that do not, in fact, have anything to do with the act of reaching the decision *per se*. To investigate the involvement of sensorimotor regions as opposed to an abstract decision-making area in perceptual decision making, we designed an experiment where participants are asked to decide if visual images represent a face or a house. There are two levels of sensory evidence, high and low, produced by mixing low or high levels of noise in the images, respectively. In other words, half the faces and houses are relatively easy to categorize, while the other half are harder to categorize. Importantly, subjects do not know how to indicate their decision (hand or eye movement and direction of movement) at the moment of the decision. Rather, subjects receive instructions to prepare either a button press or an eye movement to one of four possible targets only after the decision stage (and a variable delay). There are thus eight possible motor plans (hand or eye, four possible targets), which can only be formed after the decision has been reached. To ensure subjects reach a decision before the motor preparation stage, they are given sufficient time during the perceptual decision stage. fMRI results indicated that, at the moment of the perceptual decision, sensorimotor regions, such as LIP, are in fact *not* involved in integrating sensory evidence leading to that decision. A psychophysiological interaction analysis showed that changes in BOLD signal in DLPFC positively correlate with face and house decisions, and with the absolute difference in activation between the brain regions representing faces and houses (cf. Figure 4a). This correlation between BOLD signal changes in prefrontal cortex and face- and house-responsive brain regions was modulated by the amount of sensory evidence, as predicted by diffusion models of decision making. Interestingly, area LIP showed greater activation for greater sensory evidence, but only *after* the motor plan was known, and, specifically, only after subjects were able to start planning an eye movement to a specific target (cf. Figure 4b). In other words, only once subjects knew they would be indicating their decision with an eye movement did area

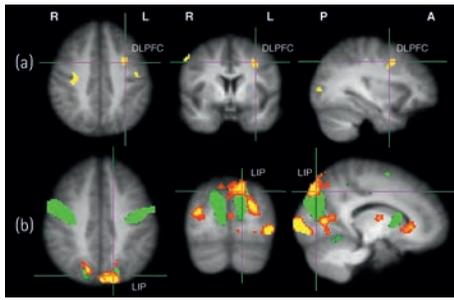


Figure 4. Averaged fMRI BOLD activations ($p < 0.01$) from 16 subjects. (a) Yellow: results of a psychophysiological interaction analysis revealing areas that correlate with the absolute difference between face and house BOLD signals (from areas FFA and PPA) during presentation of high- versus low-sensory evidence images. Area DLPFC, but not posterior parietal cortex, correlates with face versus house decisions and is modulated by the amount of sensory evidence. (b) Overlay of two BOLD activation contrasts. Green: BOLD activations greater for saccade preparation than button press preparation. Area LIP in posterior parietal cortex is indicated with crosshairs. Yellow-to-red: saccade preparation activations following a high- versus low-sensory face or house trial. Area LIP is modulated by the amount of sensory evidence, but only during the saccade preparation stage following presentation of the motor targets. R: right; L: left; P: posterior; A: anterior.

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LIP show greater activation for easy compared to difficult decisions. Thus, LIP could be characterized as representing *motor decisions*, but not *perceptual decisions* per se. This explains previous studies in which LIP was shown to correlate with the sensory evidence leading to a perceptual decision, but where the motor stage had not been disentangled from the decision stage. The confidence of the perceptual decision is passed onto the motor system, exemplifying how perception and action interact (see also Green & Heekeren, 2009).

Task Instructions and Reward Information as Modulators of Perceptual Decision Making

The diffusion model predicts that a decision (and response) will be made as soon as the boundary or threshold representing one of the possible options is reached. It is still unclear how different levels of certainty and time pressure influence the setting of this decision boundary in humans.

Furthermore, decisions often entail either positive or negative outcomes. The rewards

and punishments that are associated with different choice options are, therefore, an important factor in decision making. Recently, ideas about how the brain values different choices have been developed; however, to date, it is unclear how the systems that are involved in perceptual decision making interact with the systems that are involved in valuation. Rewards might affect sensory representations as well as motor planning or action selection; however, how this occurs in the human brain is an open question. At the most basic level, it is of interest how humans trade off speed and accuracy in decision making to optimize rewards.

Speed-Accuracy Trade-Off in Perceptual Decision Making

Decisions often necessitate a trade-off between speed and accuracy, that is, fast decisions are more error-prone while careful decisions take longer. Sequential sampling models assume that evidence for either of two response alternatives is accumulated over time. In addition, they suggest that SAT modulates the decision system by setting a lower boundary on required accumulated evidence to commit a response under time pressure.

We used MEG and a face-house categorization task, in which we manipulated sensory evidence (low, medium, high) and instructions (speed vs. accuracy) to investigate how such a speed accuracy trade-off is implemented neurally under different levels of stimulus certainty. Diffusion modeling of the behavioral data revealed that the drift rate increased with increasing sensory evidence, but did not differ significantly between instructions (speed vs. accuracy) (cf. Figure 5a). In contrast, the response threshold (boundary) differed significantly between instructions. The response threshold was lower in the speed condition compared to the accuracy condition, but did not differ with regard to sensory evidence (cf. Figure 5b).

The MEG data show that SAT modulates the later decision- and motor-related systems rather than the early sensory systems. Source analysis revealed that the bilateral SMA and the medial precuneus were more activated

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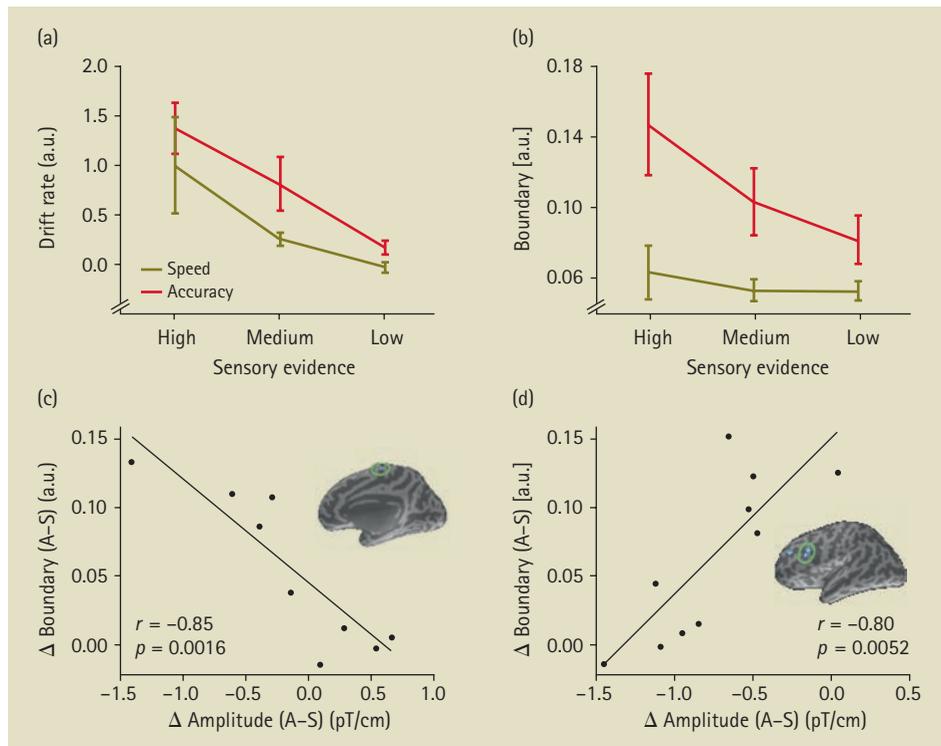


Figure 5. Modeling and neural data from a perceptual decision-making task on speed-accuracy tradeoff. Diffusion modeling of the behavioral data revealed that the drift rate increased with increasing sensory evidence, but did not differ significantly between speed and accuracy instructions (a), whereas the decision boundary differed significantly between instructions (lower in the speed than the accuracy condition and no difference over sensory evidence) (b). While pre-SMA was more active during the speed instruction and was correlated negatively with changes in decision boundary (c), DLPFC was more active during the accuracy condition and correlated positively with adjustments in the decision boundary (d).

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under speed instruction and correlated negatively (right SMA) with the boundary parameter (cf. Figure 5c), whereas the left DLPFC was more activated under accuracy instruction and showed a positive correlation with the boundary (cf. Figure 5d). The interpretation of these findings is that SMA activity dynamically facilitates fast responses during stimulus processing, potentially by disinhibiting thalamo-striatal loops, whereas DLPFC reflects accumulated evidence before response execution (Wenzlaff, Bauer, Maess, & Heekeren, 2011).

The Influence of Punishment on Perceptual Decision Making

In addition to the amount of sensory evidence and task instructions, perceptual decision making can also be influenced by other fac-

tors, such as reward and punishment. In this project, we studied how monetary punishment influences perceptual decision making. Specifically, we used a speeded perceptual categorization task in which the amount of sensory evidence and the degree of punishment were manipulated experimentally while simultaneously collecting EEG data. We subsequently combined the drift diffusion model with the EEG data to identify which of the model's internal variables (e.g., rate of integration, decision boundary) are influenced by punishment and to subsequently identify how and when these changes are represented in the brain.

As in previous studies, we found that manipulating the amount of sensory evidence had an influence on drift rate, with higher amounts of sensory evidence leading to

higher drift rates. Critical to the current project, we also found that increased punishment resulted, on average, in increased drift rates and increased decision boundaries. These findings are consistent with a decision optimization strategy in which the process of evidence integration becomes more efficient and lasts longer as punishment levels are increased.

Furthermore, we identified the EEG signals that were predictive of the changes in drift rate and boundary as a function of punishment using multiple regression analysis. We found that punishment-induced changes in EEG predicted drift rate and boundary in the diffusion model at a later stage of the decision process, starting around 400 ms after the onset of the stimulus and lasting until

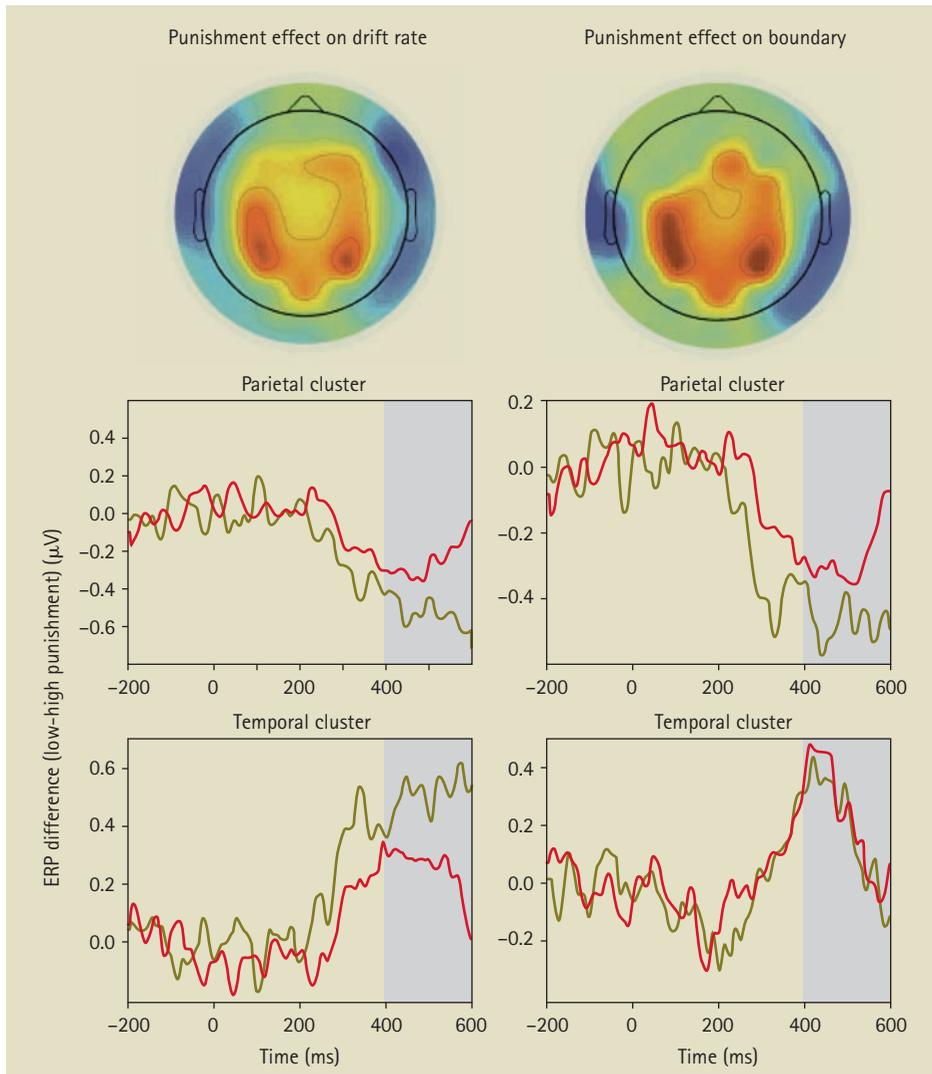


Figure 6. Spatial and temporal characteristics of the effect of punishment on drift rate (left) and boundary (right) during perceptual decision making. Note the late-onset and the ramp-like nature of differential activity between the low- and high-punishment conditions, which confirm that the effects are indeed decision related. Data are locked to the onset of the stimulus (at 0 ms). Black traces portray subjects with strong punishment effects on drift rate and boundary, whereas red traces portray subjects with smaller effects. Note that the neural data also reflect this dissociation. Finally, the similarity of the scalp distributions suggests that drift rate and boundary changes as functions of punishment are implemented in a common network.

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a response was given (cf. Figure 6, bottom). These findings suggest that, even though the components of interest are originally seen as stimulus-locked, they gradually evolve and ultimately persist until subjects make a choice, consistent with a model of temporal evidence accumulation to a decision bound. Note also the similarity in the spatial distribution of the two components (cf. Figure 6, top), which suggests that the influence of punishment on drift rate and boundary is expressed on the same neuronal populations.

Threshold Adaptation for Reward Maximization

When we make decisions under changing circumstances, the outcome depends on different trade-offs between deliberation and evidence. Decision makers determine (rewarded) perceptual decisions by collecting evidence until reaching a point of choice, the decision threshold. They can either make decisions quickly, thereby risking more errors, or make decisions carefully, thereby risking to have fewer opportunities for being maximally rewarded.

Single unit recording studies in monkeys and fMRI studies in humans have shown that frontal (e.g., DLPFC), cerebellar and striatal brain regions are involved in this form of decision making. However, it still remains unclear how their interaction gives rise to threshold adaptation. Neurocomputational models propose a modulation of the interaction (synaptic efficacy) between striatal and cortical neurons as the neurobiological mechanism by which decision makers adapt their decision criterion and thus their behavior to maximize reward.

To investigate this connectivity hypothesis, participants performed a two-alternative forced-choice direction-of-motion discrimination task (as used in many of the monkey studies by Newsome, Shadlen, and coworkers as well as some of our previous work) while we recorded changes in the BOLD signal using fMRI. Twentytwo participants performed the task repeatedly in blocks, in which reward schedules emphasized either accuracy, speed,

or were neutral (cf. Figure 7a). Hence, participants had to trade off speed and accuracy depending on the reward schedule to maximize their net reward. Assuming that participants' behavior is well described by a sequential sampling model of decision making, they could maximize their overall task reward by adjusting the amount of evidence required and the amount of elapsed time spent before making a decision.

Behavioral results and computational modeling show an effect of reward schedule on threshold modulation (cf. Figure 7b). An effective connectivity analysis (PPI) of the neuroimaging data revealed a significant modulation of the interaction of the bilateral DLPFC and striatum (stronger for the accuracy condition) and cerebellum to striatum (stronger for the speed condition) when comparing the different threshold conditions (cf. Figure 7c). If the decision process is modelled by the cognitive processing model and the fMRI data describe the same decision mechanism, threshold modulation as reflected in the strength of effective connectivity and the extent to which the decision boundary is separated between high- and low-threshold conditions should be correlated. Thus, we correlated the estimate of interaction between DLPFC and the striatum with the estimate of the boundary separation from the diffusion model. We found a significant positive correlation between those measures (shown: left DLPFC to striatum, $r = .8$ (16), $p < .0001$ and left dentate region of cerebellum, $r = -.64$ (16), p (2-tailed) = .004). The significant change in effective connectivity together with the strong positive correlation with the boundary separation provide evidence that the adjustment of decision thresholds is instantiated by a modulation of interaction between cortico-cerebellar-striatal brain systems.

This study shows that adapting decision thresholds to maximize reward is instantiated by a change in interaction between brain systems that mediate decision making. Notably, the diffusion model describes both behavioral and fMRI data well (Figure 7b, 7c).

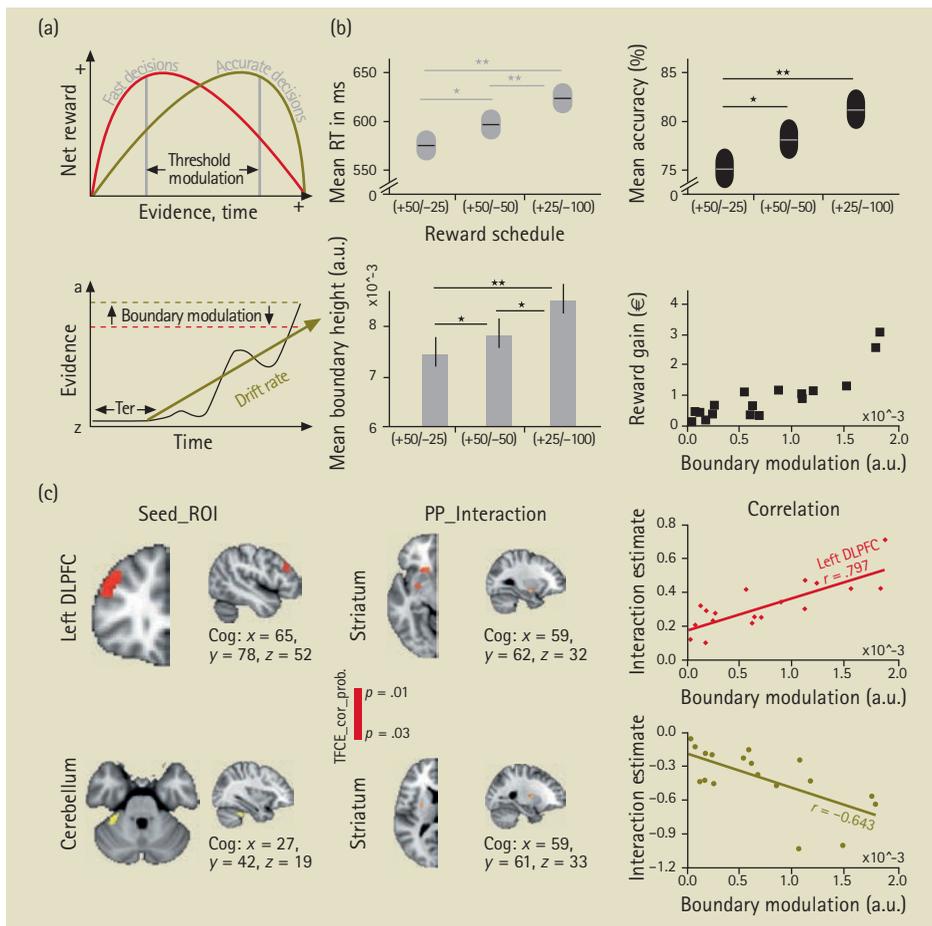


Figure 7. (a) *Top:* Threshold modulation. Distinct threshold settings are net reward maximizing for different reward schedules (red and green lines). *Bottom:* Sequential sampling framework of perceptual decision making. Modulating the boundary adjusts the tradeoffs between evidence and time. (b) *Behavioral Results.* *Top left:* black lines indicate mean and grey forms standard errors of mean reaction time (RT); low threshold state = 576.41 ms, ± 17.48 ; intermediate state = 597.04 ms, ± 17.30 ; high threshold state = 624.07 ms, $\pm 19.35\%$ correct mean, \pm SEM. *Top right:* grey lines indicate means and black forms standard errors of response accuracy (RA): low threshold state = 75.45%, ± 2.13 ; intermediate state = 78.45%, ± 2.16 ; high threshold state = 81.62%, ± 1.89 . RT and RA differed significantly between threshold states (* = $p < .05$, ** = $p < .001$; Bonferroni corrected). *Bottom left:* Normalized group boundary parameter estimates for all threshold states from the best-fitting diffusion model: low threshold state = .0739 a.u., $\pm .0035$ SEM; intermediate state = .0778, $\pm .0028$; high threshold state = .0848 a.u., $\pm .0027$. Boundary heights are significantly different between threshold states (* = $p < .01$, ** = $p < .001$). *Bottom right:* Magnitude of boundary modulation relates to reward gain. (c) *Top, from left to right:* left DLPFC seed ROIs, interacting region of the striatum ($z_{\max} = 3$), correlation of neural connectivity parameter with boundary modulation estimate (high–low threshold states) from diffusion model; Cog = Center of gravity. Red diamonds indicate individual participants' estimates of neural interaction parameters and magnitudes of boundary modulation comparing high to low threshold states. *Bottom, from left to right:* Cerebellar seed ROI. Interacting left striatal region ($z_{\max} = 3.1$). Cerebellar-striatal neural interaction estimates correlate negatively with boundary parameter modulation between high and low threshold conditions (from diffusion model). Green circles indicate individual participants' values.

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Neurocognition of Reward-Based Decision Making and Decision Making Under Risk

Many of our decisions are influenced by the potential outcomes associated with different choice options. For instance, consumers consider positive and negative product attributes prior to purchase or people use past experience to decide which means of transportation is the best to commute to work. The project *Reward & Risk* examines how people use reward- and risk-related information to achieve desired outcomes. To examine these kinds of decisions, we abstract basic features from real-life decisions, such as the type of information and feedback available, and implement them in simpler tasks, which are amenable to manipulation in an fMRI environment and to precise modeling. Conducting fMRI experiments allows us to test models and theories by examining decision variables that cannot be measured directly in behavioral experiments. Such variables are the PE in reinforcement learning models, which represents the deviation between expected and actual outcomes, or the decision threshold in sequential sampling models, which determines how much information needs to be collected before a decision is made. Further, neuroimaging techniques allow us to develop theories that describe how the brain implements decision-making mechanisms. Reward-based decision making and decision making under risk have been investigated by different disciplines that focus on different aspects of decision making. Economics and Machine Learning describe procedures that aim to maximize the decision maker's outcome or utility. Psychological theories describe how people learn from feedback and process information in general. Neuroscientific research describes which kind of information is represented in the brain and how it is manipulated to reach a decision. While it is a challenging task to examine behavior across these different levels, we believe that a solid understanding of reward-based decision making has to consider how a decision should be made, the psychological mechanisms that explain coherence with, and deviation from, maximization, and the neurobiological substrates of those mechanisms. Therefore,

to further our understanding of reward-based decision making and decision making under risk, we develop and test simple mathematical models that are derived from adaptive models of decision making and learning. These models are a central tool of our research because they allow to derive predictions for behavioral and neuroimaging data, thereby supporting the development of integrative theories that explain reward-based decision making on different phenomenological levels.

Beyond Perception: Do the Mechanisms Identified for Perceptual Decision Making Generalize to Value-Based Decisions?

Do the principles discussed above for perceptual decisions also hold for more complex decisions that are based on reward outcome, such as economic decisions?

A Mechanistic Account of Value Computation in the Human Brain

Despite much progress in understanding the neural systems that mediate reward- and value-based decision making in humans and recent results showing value-based modulations of activity in sensory cortex, it remains unclear how the brain represents different sources of probabilistic information and how they are used to compute the value signal necessary to make a decision. As discussed above, research on perceptual decision making has already established that category-selective regions in sensory cortex encode the amount of perceptual information (i. e., *sensory evidence*) used in the decision process. It was unclear, however, whether sensory regions also represent the amount of probabilistic reward information (i. e., *probabilistic evidence*) associated with different decision alternatives during value-based decisions. The lack of empirical affirmation that such regions represent probabilistic information has made it difficult to provide a mechanistic account of how different sources of probabilistic evidence are combined to compute value. Despite the fact that several studies on value-based decision making have consistently implicated the medial prefrontal cortex in encoding expected value signals, it remains unknown whether it is directly involved in

computing the value signal needed to make the decision (by combining different sources of probabilistic evidence) or whether it merely reflects the consequence of the decision process. Notably, work on perceptual decision making may provide mechanistic insights into the computation of choice values. Specifically, as discussed above, this line of research has shown that, for binary perceptual choices, decision variables are computed by integrating the difference of the outputs of neural populations, tuned to sensory evidence for each decision alternative. It has been unknown whether this mechanism also applies to the neural implementation of value-based decision making. To investigate whether a similar mechanism might be at work during value-based decision making based on perceptual information, we formed two hypotheses. First, we hypothesized that distinct brain regions represent probabilistic evidence for the different decision alternatives during value-based decision making. Second, we hypothesized that, similar to perceptual decision making, signals from these regions are combined, using a difference-based comparator operation, to compute decision value signals.

fMRI data revealed that, during binary value-based decision making, distinct regions in human ventral temporal cortex (i. e., PFG and PHG) encode abstract probabilistic evidence conferred by each of the stimulus categories. Crucially, this is the case even when the absolute amount of sensory evidence, per se, is equalized between the two categories. Furthermore, our results show that VMPFC integrates information from these regions into a value signal using a difference-based comparator operation.

These findings strongly support the hypothesis that the VMPFC is directly involved in computing the value signal by combining the different sources of probabilistic evidence using a simple subtraction operation. In this study, we thus provide a mechanistic account that directly implicates the medial prefrontal cortex in value computation. Specifically, we showed that a region in VMPFC is involved in computing decision value signals by integrating the different sources of probabilistic evidence encoded in ventral temporal cortex

(i. e., PFG and PHG) using a difference-based comparator operation. Importantly, this mechanism appears to be consistent with neurobiological and computational accounts already proposed for perceptual decision making. Single-unit recordings in primates and our own previous neuroimaging experiments in humans have shown that the DLPFC might be involved in forming a decision by comparing the output of lower level regions that encode the sensory evidence for each of the perceptual choices using a similar difference-based operation. Even though the brain regions appear to be distinct (e. g., DLPFC and VMPFC, resp.), these results suggest that perceptual and value-based decision making might share a common neural computational mechanism.

How Does the Brain Integrate Costs and Benefits During Decision Making?

When we make decisions, the benefits of a decision option often need to be weighed against accompanying costs. Thus, cost-benefit integration is an important aspect of decision making. However, value-based decision making is typically investigated in the context of decision uncertainty (e. g., Philiastides, Biele, & Heekeren, 2010), so that little is known about the neural mechanisms underlying the integration of costs and benefits as such. Cost-benefit-based decision making involves the binary decision to either accept or reject a choice option based on two competing attributes—the option's expected rewards and losses. Such binary accept versus reject decisions bear a strong resemblance to two-alternative choices in perceptual decision making discussed above. Thus, we hypothesized that cost-benefit decisions involve an analogous decision mechanism, that is, the computation of a decision variable that is based on the difference of neural reward and loss-anticipation signals. Using fMRI and choice modeling, we showed that decision making based on cost-benefit comparisons can be explained as a stochastic accumulation of the cost-benefit difference (see Figures 8 to 10). Model-driven fMRI showed that VMPFC and left DLPFC compare costs and benefits by computing the difference between

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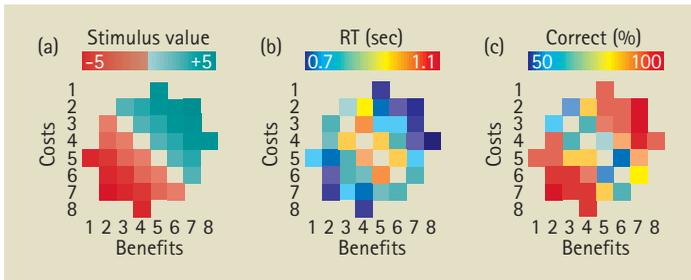


Figure 8. The cost-benefit decision task and behavioral results. Panel (a) shows combinations of costs (X axis) and benefits (Y axis), which participants could either reject or accept. The color code (not visible to participants) displays the net value of a stimulus. Panels (b) and (c) show reaction times and accuracy for the different stimuli. Consistent with basic properties of diffusion models of decision making, participants were faster and made fewer errors when the absolute cost-benefit difference was larger. Accordingly, we could successfully model participants behavior with a diffusion model and used the resulting drift-rate parameters in the fMRI analysis.

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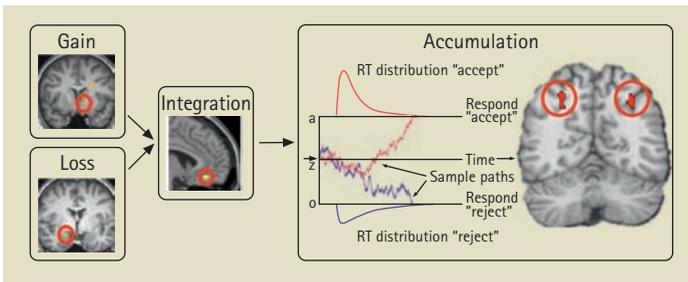


Figure 10. Summary of the fMRI results. The expected gain and loss of stimuli were represented in the ventral striatum and the amygdala, respectively. The difference between these neural value signals is computed in the ventromedial prefrontal cortex. A decision is formed by accumulating this difference signal in the middle intraparietal sulcus until a decision threshold is reached.

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neural benefit and cost signals in ventral striatum and amygdala, respectively. Importantly, a PPI analysis showed that participants with higher drift rates as estimated in a diffusion model showed a better integration of neural cost and benefit signals in the VMPFC. Moreover, changes in BOLD signal in the bilateral middle intraparietal sulcus reflect the accumulation of the difference signal from VMPFC. Activation in these regions was weaker when the cost-benefit difference was high and it correlated negatively with the cost-benefit differences signal in the VMPFC (see Figure 10). In sum, these results show that a neurophysiological mechanism previously established for perceptual decision making,

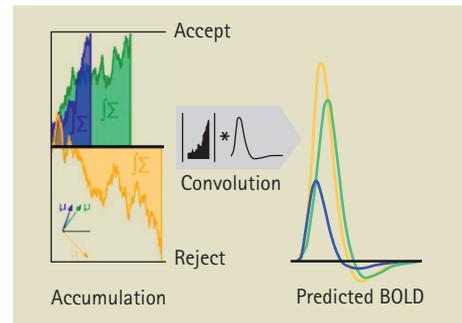


Figure 9. Relation between drift rate and brain activation. The left side of the figure shows hypothetical decision processes with high (blue), medium (green) and low (yellow) drift rates. Convolving this accumulation activation with a hemodynamic response function results in the greatest BOLD activation for easy decisions characterized by a high drift rate and weakest BOLD activation for hard decisions characterized by a low drift rate.

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that is, the difference-based accumulation of evidence, is fundamental also in value-based decisions. The brain thus weighs costs against benefits by combining neural benefit and cost signals into a single difference-based neural representation of net value, which is accumulated over time until the individual decides to accept or reject an option.

This project was carried out in collaboration with Ulrike Basten and Christian Fiebach (Emmy Noether Group, University of Frankfurt a. M.).

How Does the Brain Integrate Different Attributes of One Choice Option?

In a related study, we investigated more closely how different values of an object are integrated into an overall subjective value. Behavioral economics has investigated value-integration mechanisms to predict choice behavior across a distribution of positive and negative values. Multiattribute-utility theory suggests that the subjective value of multiattribute options equals the attributes' weighted sum. Although these models can predict choice behavior well, they are only applicable when preferential independence of the attributes is given. However, human choice often violates the independence principle; that is, when selecting a dinner menu, together with cheese, red wine has a higher

value over white wine. But, with fish, white wine has a higher value. Here, an independent model fails to predict choice, whereas an interactive integration model would successfully predict choice by permitting an extra term for the dependence of attributes. Here, we investigated how the brain integrates values across discrete stimuli into one subjective value to guide decision making. For this, we have developed a decision-making task with multiattribute choice options. We measured the BOLD signal with fMRI while subjects accepted or rejected choice options that were combinations of monetary reward and physical pain. Hence, the attributes of a choice option not only have different valence (positive and negative values) but also are qualitatively different. A well-established approach to investigate cognitive processes underlying decision making is to compare cognitive models on behavioral data. However, if competing models predict the same pattern of choices, behavioral data are limited. In these cases, forcing the models to predict neural activity can provide decisive evidence. Here, we compare computational models directly on both behavioral and neural data. These models either integrate values independently (each value contributes to the overall subjective value) or interactively (the value of one attribute impacts the valuation process of the other attribute). Interestingly, these models all made similar predictions of individual choice behavior, suggesting that behavioral data alone are not sufficient to uncover the underlying integration mechanism. A direct model comparison on brain data decisively demonstrated that interactive value integration predicts neural activity in value sensitive brain regions, such as VMPFC and DLPFC, significantly better than the independent mechanism (see Figure 11). Furthermore, our effective connectivity analyses revealed that value dependent changes in valuation are associated with modulations in SGACC-amygdala coupling. These structures have been shown to play a key role in regulating hedonic experiences, such as fear and pain regulation, via placebo, suggesting a more generalized role of these regions.

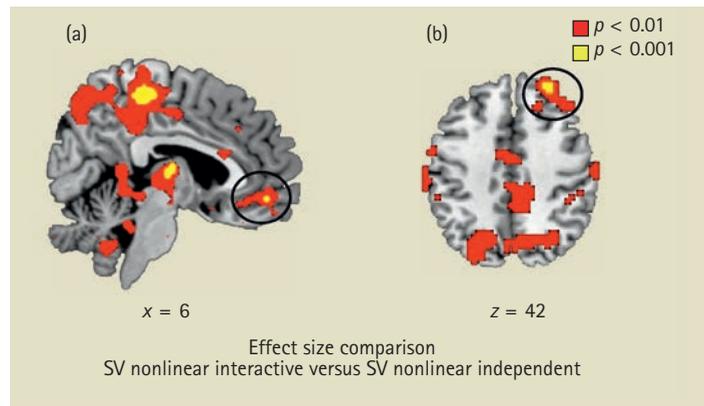


Figure 11. *Direct comparison between nonlinear interactive versus nonlinear independent models on neural data. Brain regions showing significantly larger effect sizes for the nonlinear interactive model compared to the nonlinear independent model. Slices represent sagittal (left) and transversal (right) views of structural brain images with superimposed statistical maps. The circled areas indicate (a) anterior VMPFC (BA 11, [6, 48, -9], $t_{92} = 3.18$, $p < .001$) and (b) DLPFC (BA 9, [30, 45, 42], $t_{92} = 3.78$, $p < .001$).*

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With this study, we show that value impacts valuation when advantages and disadvantages are integrated into an overall subjective value. This study provides a concrete example of how neuroimaging allows to test between computational models of decision making and facilitates the evaluation of models of cognitive computations. This study was carried out in collaboration with Jörg Rieskamp (Economic Psychology, University of Basel). A manuscript reporting these findings is currently under review.

Neural Processing of Risk

In our everyday life, we often have to make decisions with risky consequences, like choosing a restaurant for dinner or choosing a form of retirement saving. To date, however, little is known about how the brain processes risk. Recent conceptualizations of risky decision making highlight that it is generally associated with emotions, but do not specify how emotions are implicated in risk processing. Moreover, little is known about risk processing in nonchoice situations and how potential losses influence risk processing. Here, we investigated (a) how risk processing is influenced by emotions, (b) how it differs between choice and nonchoice situations, and

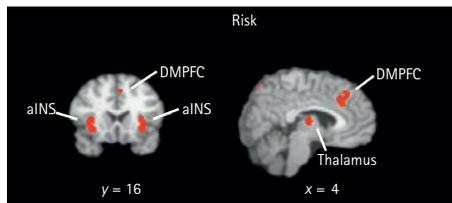


Figure 12. Neural representations of risk. Results from an ALE meta-analysis on risk independent of the context (choice or nonchoice situation) and the domain (gains+losses or only gains in which risk was investigated). Activated clusters included bilateral aINS, DMPFC, and thalamus (FDR < .05; cluster size > 200 mm³).

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(c) how it changes when losses are possible. By using the ALE meta-analysis, we can base our argumentation not only on a single study or a qualitative view on several studies but also on a quantitative integration of many studies investigating risk. Importantly, the ALE meta-analysis can also be used to contrast two independent sets of foci. We identified a network including bilateral aINS, dorsomedial thalamus, posterior thalamus, DMPFC, right DLPFC, and right parietal cortex for processing risk (see Figure 12). The aINS was active in both choice and non-choice situations, but predominantly when

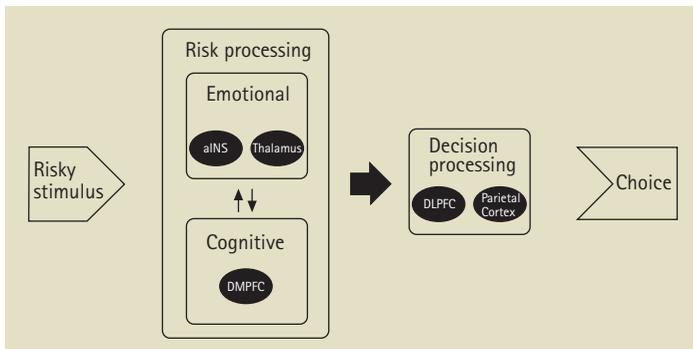


Figure 13. A potential mechanism of risky decision making. A risky stimulus, such as a gamble, with uncertain outcomes or a choice menu with different financial investments is initially evaluated on an emotional level. Activity in the aINS thereby serves as an estimate for the potential of the risky stimulus to result in an unwanted outcome, whereas the thalamus reflects important aspects of potential outcomes (e.g., their variability). At the cognitive level, the risky stimulus is processed in the DMPFC. Both parts of risk processing (emotional and cognitive) inform the actual decision process performed in DLPFC and parietal cortex. In situations in which no decision has to be made, such as in the bingo game, the process concludes after risk processing.

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individuals were faced with potential losses. The aINS is regarded as a key brain region in emotion processing and arousal and also in the mapping of internal bodily states. Several studies related activity in the aINS especially to aversive emotions, such as fear, sadness, disgust, or anxiety. Thus, our results support the hypothesis that aversive emotions are implicated in risk processing independent of the context, but predominantly (not solely) when individuals are faced with potential losses.

In sum, our finding of insula activity supports the hypothesis that emotions are implicated in risk processing. We also find differential activation patterns for choice and nonchoice situations and for the gain versus gain+loss domain that suggest that risk processing on the neural level is context dependent and specifically influenced by potential losses. Based on the results of our meta-analyses, we propose the account of a risk-processing mechanism illustrated in Figure 13.

Neural Foundations of Risk-Return Trade-Off in Investment Decisions

Many decisions people make—such as whether to try to catch a yellow light, choosing a journal for submission of an article, or choosing a financial investment—can be described as decisions under risk. Understanding the mechanisms that drive these decisions is an important goal in decision neuroscience. But while recent research has generated some progress in the understanding of value-based decision making, the underlying mechanisms of risky decision making are still debated.

Two classes of risky decision-making models have been proposed that can be applied to investment decisions in general, one based on a transformation of outcomes and/or probabilities (EUT and PT) and the other based on a risk-return trade-off (risk-return models). To be superior to other models, a better model should, in the best case, explain behavioral and neural data better than the other models. As value and choice predictions of both classes of models are usually highly consistent with each other, we focused on the question of which class of models better

describes the valuation process in the brain. In this case, fMRI data can serve as a tiebreaker because they provide additional insight into the neurobiological processes that subserve the cognitive processes ultimately leading to decisions.

Using the RPID task, which mimics real-life investment decisions by providing subjects with past returns of investments, we found that brain activity in bilateral DLPFC, PCC, VLPFC, and MPFC covaried with value and return. Activation in these regions has usually been observed in the context of value and reward. Changes in the BOLD signal in these regions correlate with the magnitude of experienced and anticipated rewards as well as with the subjective value of (delayed) rewards and the willingness to pay for consumer goods.

We found that *perceived risk* correlated significantly with the BOLD signal in the aINS. Risk-related brain activity in the aINS was observed in a variety of studies (e.g., Mohr, Biele, & Heekeren, 2010). None of these studies, however, used lotteries with continuous distributions. Thus, our finding supports the results of previous studies and extends them by showing that risk is represented in the aINS in situations where subjects have to make a choice between two independent alternatives where one alternative is described by a continuous distribution of possible outcomes. Most importantly, the existence of a neural representation of risk during choices offers neural support for risk-return models because, in the case of EUT and PT, one would not expect a neural representation of risk, whereas risk is explicitly specified in risk-return models.

We further found that interindividual differences in decision-related brain activity in LOFC and PCC covaried with interindividual differences in risk attitudes derived from the psychological risk-return model, which provides additional support for this model. The more risk averse a participant was, the greater was her decision-related change in brain activity in LOFC and PCC (independent of current risk and value). In sum, we found support for the hypothesis of a risk-return trade-off in investment decisions.

Neuroeconomics and Aging: Neuromodulation of Economic Decision Making in Old Age

Neuroeconomics has made important progress in grounding different aspects of decision making in neural systems and the neurotransmitters therein. Evidence from a range of fMRI studies indicates that the VST and the VMPFC are implicated in the representations of reward and value (see above). In the context of risk processing, many studies have shown two key regions to be involved—the ACC and the aINS (e.g., Mohr, Biele, & Heekeren, 2010). Some recent studies have also investigated the effect of delayed rewards and showed that the subjective value of delayed rewards covaries with brain activity in VST, VMPFC, and PCC. The dopaminergic and serotonergic brain systems have been identified as key neurotransmitter systems involved in economic behavior influencing all three aspects of economic decision making discussed above (reward, risk, and delay). Whereas dopamine and serotonin separately influence both reward and risk processing they are also assumed to interact in implementing prediction signals that reflect the temporal information about the outcome.

Both neurotransmitters are known to be prone to significant changes during the adult lifespan (see the Center for Lifespan Psychology's project Neuromodulation of Lifespan Cognition, pp. 183–189). Similarly, economic behavior undergoes significant age-related changes over the course of the adult lifespan. Several studies indicate that older adults are more risk averse than younger adults and that discount rates increase with age. These changes were reflected in changes in activation patterns observed while individuals make economic decisions. Although older adults show intact striatal activation during gain anticipation, one can observe a relative reduction in activation during loss anticipation. They also show higher activations in the aINS when choosing risky choice alternatives, indicating that they perceived the alternative as more risky compared to younger adults. Together with our colleagues from the Center for Lifespan Psychology, we have recently

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begun investigating the triadic relationship between (a) economic decision making, (b) dopaminergic and serotonergic neuromodulation, and (c) aging.

Decision Making in Social Contexts

Most of our decisions in everyday life have to be taken in social contexts, and much of our success in life depends on how well we do in interacting with others. Making inferences about the mental states of others, which is an important aspect of social cognition, is at the core of what enables us to predict the behavior of others. Basic perceptual and cognitive processes, such as the reading of facial expressions and the decoding of prosodic cues, represent a prerequisite for social cognitive functions. Social decision making, however, is not only the result of perceptual and cognitive operations but also of emotional processes. In fact, in a collaborative project with the Center for Adaptive Behavior, we recently found that emotional personality characteristics as measured via self-report questionnaires, such as levels of empathic concern, are much stronger predictors for prosocial behavior in economic games, such as the dictator game, than cognitive parameters, such as the ability to take other people's perspective. Thus, the common goal of our subprojects within the topic of decisions in social contexts is to elucidate the unique as well as combined contributions that these perceptive, cognitive, and emotional processes have on social decision making. Using structural and functional MRI as well as psychophysiological measures, such as eye tracking and skin conductance, our group is trying to elucidate how and where in the brain of healthy individuals social decisions are made. Moreover, to complement our understanding of the "social brain," we are studying individuals with neuropsychiatric conditions that involve socioemotional impairments, such as autism.

Emotional Face Processing

The study of face-processing abilities, such as facial emotion or identity recognition, is of particular importance for social decision making because faces represent a crucial source

of social information, and their decoding is a precursor for more complex social inferences. In ASC, abnormalities in processing information from faces, in particular from the eyes, are characterized by specific scan paths on emotional faces. The first two subprojects in this section follow up on our findings from eye tracking and structural MRI studies in ASC (Dziobek, Bahnemann, Convit, & Heekeren, 2010; Kirchner, Hatri, Heekeren, & Dziobek, 2011) seeking to further specify atypical gaze behavior and emotional face-processing impairments observed in autism. Atypical gaze in ASC is prominently characterized by a reduced focus toward the eyes, yet the reason for this abnormality remains a puzzle. A long-standing view suggests that a general lack of social attention—and specifically less attention toward the eyes—leads to a reduced orientation toward the eyes. Another view, however, underlines the potential aversiveness of direct eye contact in ASC, resulting in an active avoidance of direct eye contact. Importantly, these two processes do not have to be mutually exclusive, instead, the interplay of the two components may, in fact, account for the observed scan paths. In the first project (Kliemann, Dziobek, Hatri, Steimke, & Heekeren, 2010), we sought to investigate the influence of reduced orientation and active avoidance of the eyes on atypical gaze in ASC by analyzing participants' eye movements during emotional face processing. To this end, we applied a new behavioral facial emotion classification task, which was developed in collaboration with Matthias Gamer and Christian Büchel (University of Hamburg). The task varies the initial fixation position of faces (displaying happy, fearful, or neutral expressions), so that participants started processing a face either at the eyes or at the mouth (cf. Figure 14a). Thereby, the task allows investigating both avoidance- and orientation-guided reflexive gaze behaviors, triggered by focusing the eyes or the mouth, respectively. Participants in the control group (NT, $n = 12$) showed an increased preference for the eye region, with more eye movements toward the eyes (when starting on the mouth) than away from the eyes (toward the mouth) (cf. Figure 14b, 14c),

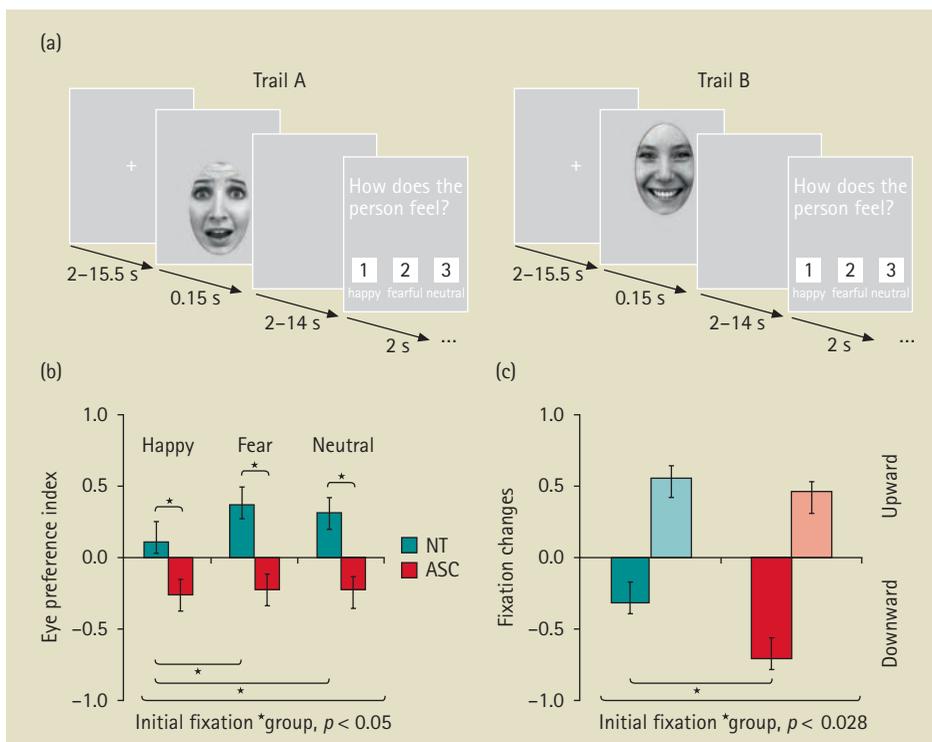


Figure 14. (a) Emotion classification task. Each trial started with the presentation of a fixation cross (2 s), followed by an emotional face (150 ms). After a blank screen for 2 s participants indicate the emotion displayed. Faces were shifted vertically on the screen so that subjects started gaze either on the eyes (Trial A) or on the mouth (Trial B) of the presented emotional face. (b) Eye preference index. Generally, the NT group showed an increased preference for the eyes, compared to ASC. For the NT group, the preference was stronger for fearful and neutral faces, compared to happy faces. There was no effect of emotion in the ASC group. (c) Eye movements as a function of initial fixation. The ASC group showed more fixation changes downward away from the eyes than the NT group.

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replicating findings from our collaboration partners. In contrast, participants in the autism group ($n = 11$) showed a clear reduction of eye preference, prominently characterized by more and faster eye movements away from the eyes than toward the eyes. In addition, eye preference in ASC predicted emotion recognition performance independent of general illness severity. These findings emphasize an increased avoidance of eye contact on the oculomotor level. Impairments in emotional face processing in autism, however, are not only prominent on a behavioral and oculomotor level but also on the level of brain function and structure. As previous studies from our group showed, problems in face processing in autism are associated with pathological structural

characteristics of brain regions relevant for face processing, such as increased cortical thickness of the fusiform gyrus and distinct connectivity patterns of the amygdala in autism (Dziobek et al., 2010).

On a functional level, emotion processing and atypical scan paths have been repeatedly reported along with aberrant amygdala activity during face processing in ASC as compared to control participants. Whereas, in controls, amygdala function seems to be linked to the above reported strong and immediate focus toward the eyes, the functional role of the amygdala within emotional face processing in autism has been rather controversial. Previous studies reported both hyper- and hypoactivation of the amygdala as compared to controls in response to facial stimuli. Find-

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ings of decreased amygdala activation in ASC rather emphasize the hypothesis of a missing orientation as an explanation for the observed reduced eye focus. On the contrary, findings of increased amygdala activation together with a positive correlation of eye fixation duration rather favor the avoidance hypothesis in ASC. To further specify the functional role of the amygdala in atypical gaze during emotional face processing, we conducted a second subproject where participants performed the same task as in the behavioral subproject while in an MRI scanner. A significant cluster of activation in the right amygdala for the interaction of initial fixation position (eyes vs. mouth) and group (ASC vs. NT) revealed an increase of amygdala activity when control participants started looking at faces from the mouth (and orient toward the eyes) as com-

pared to starting at the eyes (cf. Figure 15). This is consistent with previous studies and the idea of an involvement of the amygdala in successful orientation toward the eyes. Contrarily, the ASC group showed increased amygdala activity in the same cluster when starting fixation at the eyes, along with reduced amygdala activity when starting at the mouth as compared to controls. These data provide new and important insights into the aberrant functioning of the amygdala within social information processing in autism: The increase in amygdala activity triggered by direct eye contact along with previously reported increased gaze away from the eyes, supports the hypothesis of active eye avoidance, modulated via avoidance processing in the amygdala. The decrease of BOLD response in the amygdala in ASC when starting gaze at the mouth further underlines dysfunction of the amygdala within social saliency detection and face processing. The results of this subproject describe a specific dysfunctional mechanism of social relevance mediation in the amygdala in autism, further supporting the emerging opinion that the amygdala is not the cause of the entire autistic pathophysiology, but rather represents a dysfunctional node within the neuronal network underlying effective social functioning resulting in the social phenotype of autism.

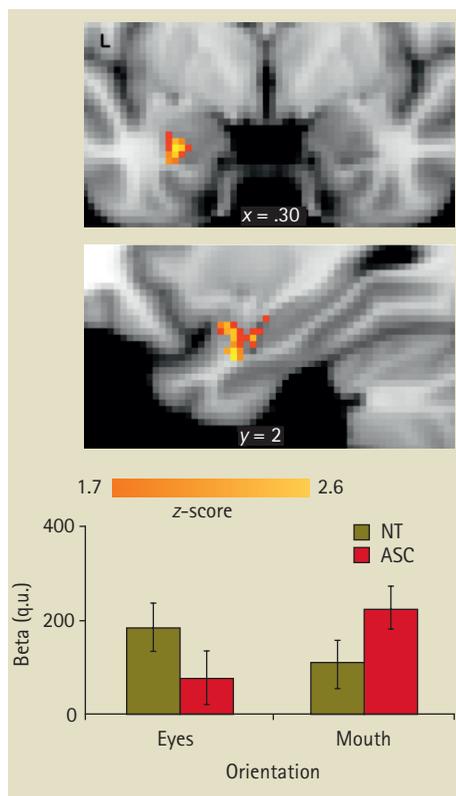


Figure 15. Amygdala region showing a significant interaction of initial fixation position and group. The upper two panels show statistical maps of coronal and left (L) sagittal planes. The lower bar shows the extracted beta values of the cluster ($p = .05$ [FWE corrected]). Error bars represent SE.

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Complex Social Decision Making

Successful functioning within the social environment does not only involve decisions about emotional states from visual features of other agents' faces but also demands to predict and explain behavior of others based on mental state inference within complex social situations. Another core symptom of ASC compromises difficulties in recursively inferring intentions and beliefs of others within complex social interactions. To further specify the cognitive dysfunctions that determine the heterogeneity in ASC, we employed a game-theoretic approach to characterize unobservable computational processes implicitly involved in social interactions and their dysfunctions in ASC. The subproject was realized in collaboration with Wako Yoshida, Karl Friston, and Ray Dolan (University College of

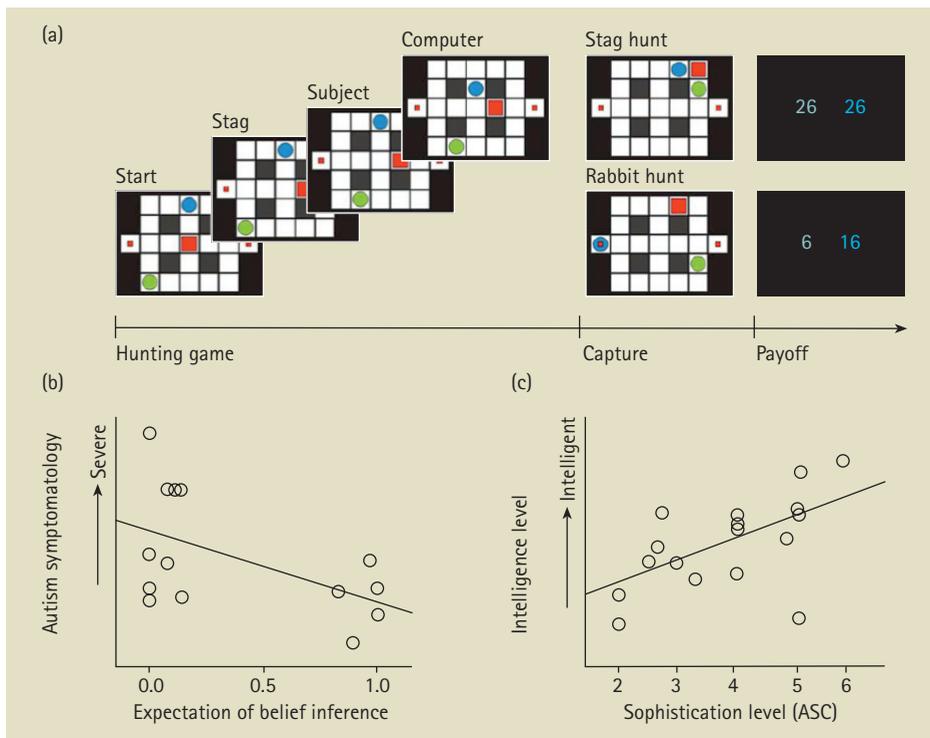


Figure 16. (a) Stag-hunt game. Two players, the participant (green circle) and a computer agent (blue circle), try to catch prey: a mobile stag (big square, big payoff) by cooperation or two stationary rabbits (small squares, small payoff), by moving in a sequential manner. When a game is finished, both players receive points according to the sum of prey and points regarding to the remaining time. (b) The greater the expectation of recursive belief inference, the more severe was the autistic symptomatology ($n = 14$, $r = -.52$, $p = .055$). Autistic symptomatology was measured by the sum of scores of the autism diagnostic interview revised (ADI-R) and the autism syndrome diagnostic interview (ASDI). (c) Estimated sophistication for the ASC group was significantly correlated with individual IQ-scores ($n = 17$, $r = .54$, $p = .026$).

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London). The approach employed a stag-hunt game, in which participants interacted with a computerized agent to hunt stags together (high value) or defect to hunt rabbits alone (low value) (cf. Figure 16a). Within the game, cooperation depends on recursive representations of others' intentions, since, if I decide to hunt the stag, I must believe that you believe that I will cooperate with you. Cooperation emerges, when highly sophisticated players interact. Over the course of the game, a computerized agent shifted its sophistication (by three degrees of recursion) without notice. For optimal behavior, participants were required to (1) estimate the agent's sophistication level (recursive belief inference), (2) update their own strategies continuously (cognitive flexibility), and (3) behave optimally on the basis

of their inference (interactive planning). To tease apart cognitive processes implicit in social interaction, we applied a previously developed theoretical model, in which participants behave optimally with respect to the goal of maximizing the payoff based on these three processes. ASC showed a general understanding of the stag-hunt game, but the observed behavior was guided to a lesser degree by belief inference than that of the control group. Instead, ASC participants' behavior was better explained by a fixed strategy model, that is, disregarding the other player's beliefs during the decisions in the game. Strikingly, the extent to which they behaved according to the fixed strategy was predicted by symptom severity (cf. Figure 16b). In addition, intellectual levels predicted the ability in iterative

planning: highly intelligent players behave cooperatively as if they make predictions with a longer time horizon (cf. Figure 16c). This study not only provided the first quantitative approach revealing the underlying computational dysfunctions that represent the autistic "spectrum" but also highlights the power of simple assessments for psychopathology for describing and understanding core psychiatric deficits in terms of computational dysfunctions.

Abbreviations

ACC – anterior cingulate cortex
aINS – anterior insula
ALE – activation likelihood estimation
ASC – autism spectrum conditions
DLPFC – dorsolateral prefrontal cortex
DMPFC – dorsomedial prefrontal cortex
EEG – electroencephalography
EUT – expected utility theory
fMRI – functional magnetic resonance imaging
LIP – lateral intraparietal area
LOFC – lateral orbitofrontal cortex
MEG – magnetencephalographic
MPFC – medial prefrontal cortex
NT – neurotypical subjects
PCC – posterior cingulate cortex
PE – prediction error
PFG – posterior fusiform gyrus
PHG – parahippocampal gyrus
PPI – psychophysiological interaction
PT – prospect theory
RPID – risk perception and investment decision
rTMS – repetitive transcranial magnetic stimulation
SAT – speed-accuracy trade-off
SGACC – subgenual anterior cingulate cortex
SMA – supplementary motor areas
VLPFC – ventrolateral prefrontal cortex
VMPFC – ventromedial prefrontal cortex
VST – ventral striatum

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Max Planck Research Group

Affect Across the Lifespan

Max Planck Research Group

The **Max Planck Research Group "Affect Across the Lifespan"** (Head: Michaela Riediger) investigates age differences in affective experiences and competencies from adolescence to old age. A first research emphasis on *affect dynamics* involves investigations on age differences in the inner experiences, outward expressions, and physiological processes associated with affective experiences, and on their underlying mechanisms. A second research emphasis on *affective competencies* focuses on age differences in abilities related to understanding and managing emotional aspects of life. The group began its work in 2009.



Research Staff 2009–2010

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Introductory Overview

How do emotional experiences change from adolescence to old age? And how does the ability to understand and deal with affective aspects of life develop across the lifespan? The Max Planck Research Group "Affect Across the Lifespan," which began its work in January 2009, seeks to contribute to a better understanding of these questions. Without the abilities to experience, express, understand, and control affective states—such as anger or joy—we would not succeed in many life tasks, from forming and maintaining social relations to successfully pursuing a career. The purpose of this Research Group is to contribute new insights on age-related differences in these various facets and competencies of affective functioning, focusing primarily on the age range from adolescence to old age. Unique features of our research approach are the combination of a mobile-phone based experience-sampling technology with psycho-physiological monitoring and well-controlled experimental paradigms, and the consideration that affective functioning takes place in, and is influenced by, the individual's social context.

Research Emphases

Our work is characterized by two interrelated research emphases. A first emphasis on *affect dynamics* involves 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* is characterized by empirical investigations on age-related differences in abilities related to understanding and managing emotional aspects of life.

This report gives an overview of our research activities regarding both research emphases in the period from 2009 to 2010. We start out with our research on affect dynamics by first providing an overview of the longitudinal Multimethod Ambulatory Assessment (MMAA) Project, which is the primary database of our respective investigations, and by summarizing the research questions that we have recently addressed using this

database. Following this, we illustrate two specific research examples in more detail and then turn to our second research emphasis on age-related differences in affective competencies.

Research Emphasis 1: Age-Related Differences in Affect Dynamics

Empirical Basis: The Multimethod Ambulatory Assessment (MMAA) Project

The MMAA Project is a longitudinal research endeavor that was initiated in 2007 by Michaela Riediger, Ulman Lindenberger, and Gert G. Wagner. Since then, three longitudinal measurement phases have been completed and a fourth one is currently under way (see

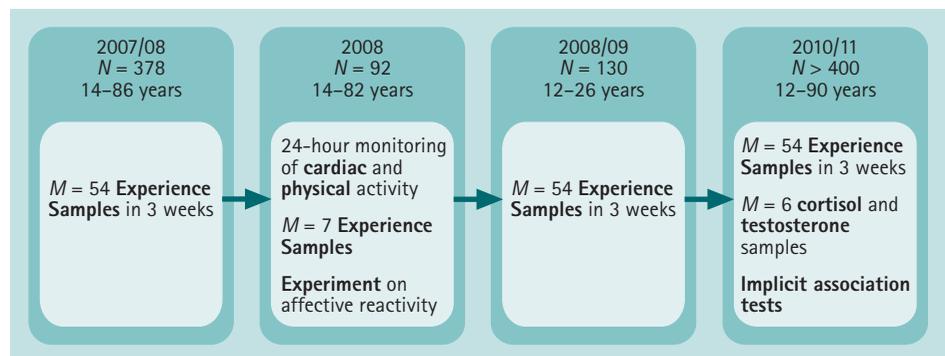


Figure 1. Overview of the longitudinal MMAA Project. Between 2007 and 2010, four assessment phases have been conducted in a sample ranging in age from adolescence to old adulthood. New participants, and young adolescents in particular, have been regularly recruited to maintain the age composition of the sample. The measurement approach combines various ambulatory assessment techniques, which allow the measurement of affective, physiological, and cognitive functioning in participants' daily lives and natural environments, with well-controlled experimental paradigms and interviews conducted in the participants' homes. The ambulatory assessment techniques include mobile-phone based experience sampling as well as various ambulatory biomonitoring devices.

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Figure 1). 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 ranging in age from adolescence to old adulthood. To meet this aim, we combine several ambulatory assessment methodologies, which allow measurements of experiences, cognitive capacity, and physiological processes in daily-life contexts, with interview techniques and well-controlled experimental paradigms. Ambulatory assessment methods include mobile-phone based experience sampling (see Figure 2), and ambulatory biomonitring of cardiac activity (assessed via 24-hour electrocardiography), physical activity (assessed via 24-hour accelerometry), and hormonal processes (assessed via repeated ambulatory saliva samples).

Primary investigators of this project are Michaela Riediger and Cornelia Wrzus (since 2009). Gert G. Wagner, head of the German Socio-Economic Panel Study and Max Planck research fellow, is a co-investigator. Parts of the project have been conducted in collaboration with Ulman Lindenberger, Viktor Müller, Andreas Brandmaier (all Center for Lifespan Psychology), and Florian Schmiedek (German Institute for International Educational Research).

During the first phase of the project—conducted in 2007 and 2008 and largely funded by the Federal Ministry for Education, Science, Research, and Technology (grant ID MPI001)—we developed an experience-sampling technology (Hoppmann & Riediger, 2009; Riediger, 2009) that allows the capturing of experiences—such as events, behaviors, feelings, or thoughts—at the moment of their occurrence and within the context of a person's everyday life, using mobile phones as assessment instruments (see Figure 2). This technology also makes it possible to assess within-person fluctuations in cognitive capacity over time.

In 2007 and 2008, we first applied this technology in a 3-week experience-sampling phase of 378 participants ranging from 14 to 86 years of age, obtaining an average of 54 repeated assessments per participant.

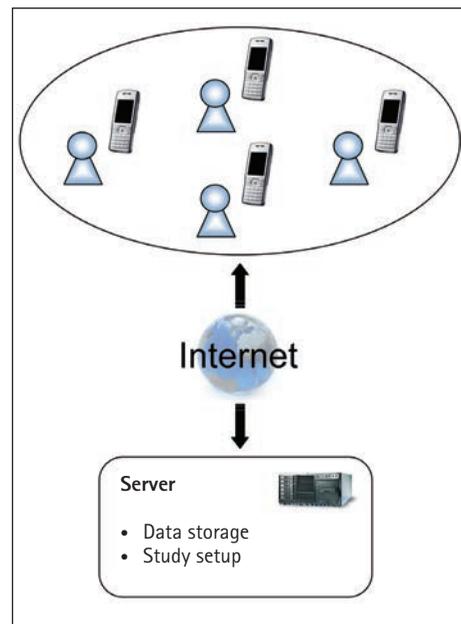


Figure 2. Using mobile phones to sample experiences in day-to-day life. Participants are provided with mobile phones that they carry with them at all times while pursuing their daily routines. On these phones, a testing software is installed that controls the participants' assessment schedule and that initiates, several times a day, that the mobile phone rings and thus signals the participants to complete the assessment instrument which refers to the participants' momentary experiences and also includes cognitive tasks. Participants complete the instrument using the mobile phone's keypad. Participants' responses are immediately uploaded via the Internet to a central server. The server is accessible to the researchers via a web interface, which allows them to set up and modify study designs and content and which displays information according to each participant's assessment schedule and response compliance.

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On an average of eight and a half months later, we continued this project using an ambulatory biomonitring system to additionally investigate physiological aspects of affective functioning in daily life. Here, we followed up a subsample of 92 participants from 14 to 82 years of age, adding a 24-hour ambulatory biomonitring of physical and cardiac activity to the mobile-phone based experience-sampling methodology and combined this with an experimental laboratory phase. This second measurement phase was also partly funded by the Federal Ministry for Education, Science, Research, and Technology (grant ID 01UW0706).

A third longitudinal assessment phase again included a 3-week experience-sampling wave and was conducted from 2008 to 2009 with the adolescent and young adult participants of the initial sample. In addition, new adolescent participants were recruited to the sample, lowering the lower bound of the sample age to 12 years.

Data collection of a fourth longitudinal assessment wave was started in November 2010 and will be completed in the summer of 2011. Again, a 3-week experience-sampling phase is conducted, this time including the entire sample (more than 400 participants aged 12 to about 90 years) and 20 newly recruited participants in early adolescence. This fourth assessment wave additionally incorporates six ambulatory assessments of cortisol and testosterone levels (using saliva samples) to investigate the role that hormonal processes play in age-related differences in affective functioning, particularly in adolescence. In addition, we implement an experiment to assess age-related differences in participants' implicit representations of affective experiences.

Our analyses of this rich data set so far have primarily focused on the following research topics:

- (1) Age differences in prohedonic and contra-hedonic orientations
- (2) Age differences in affective and physiological responding to, and recovery from, adverse events
- (3) Age differences in the associations between sleep quality and emotional well-being
- (4) Age differences in associations between affective and physiological arousal and working-memory capacity

In the following sections, we exemplarily describe the first two of these research foci in more detail.

Research Example 1: Age Differences in Prohedonic and Contra-Hedonic Orientations

Evidence is accumulating that day-to-day emotional experiences differ between individuals from different age groups. Adolescence, for example, is typically characterized by relatively more emotional turmoil and a relatively

higher prevalence of negative emotionality than adulthood. Across adulthood, there are also typical patterns of age-related differences. When repeatedly asked to report their momentary feelings, older adults typically report higher emotional well-being in their daily lives than younger adult age groups, and this difference cannot be explained by age-related differences in daily activities and time use (Riediger & Freund, 2008).

The psychological mechanisms underlying these age-related differences in daily-life affective experiences are not yet well understood. Using data from the first assessment phase of the MMAA Project, we investigated the assumption that considering the proactive aspects of affective experience might provide new insights in this respect (Riediger, Schmiedek, Wagner, & Lindenberger, 2009). We assumed that parts of the age-related differences in everyday emotional well-being might be brought about by differences in how individuals wish to influence their feelings. Hence, we expected to find that age-related differences in everyday emotional well-being are mirrored by age differences in affect-regulation motivation. Specifically, we expected *contra-hedonic* motivation—that is, the wish to maintain or enhance negative affect or to dampen positive affect—to be most prevalent among adolescents. This hypothesis was based on the idea that exploring negative and nonconforming emotional experiences is one way by which adolescents repudiate conventions in order to seek emotional autonomy of parents and other adults and to test their identities.

We also predicted *prohedonic* motivations—that is, the wish to maintain or enhance positive affect or to dampen negative affect—to be most prevalent among older adults. This prediction was in line with the theoretical claim that the shrinking horizon of time-to-live is shifting older people's motivations toward wanting to maximize their emotional well-being in the here and now. Irrespective of participants' age, we further expected *contra-hedonic* orientation to be more effortful than *prohedonic* orientation as it requires overriding of prepotent regulatory tendencies. Based on resource-allocation

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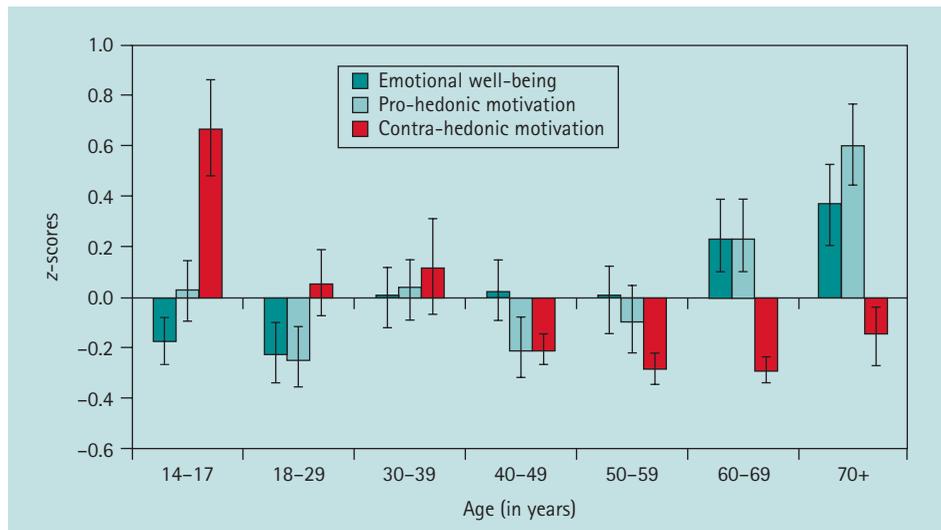


Figure 3. Age differences in regulatory orientations mirror age differences in everyday emotional well-being. Using a mobile-phone based experience-sampling technology in 378 individuals ranging from 14 to 86 years of age, we investigated age differences in emotional well-being and in how people want to influence their feelings in their daily lives. Emotional well-being and prohedonic and contra-hedonic orientations are depicted as standardized deviations from sample mean. Older adults reported comparatively higher emotional well-being in their daily lives than younger age groups. Contra-hedonic motivation was comparatively most prevalent among adolescents, whereas prohedonic motivation was comparatively most prevalent among older adults.

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models of cognitive capacity, we therefore hypothesized that contra-hedonic, as compared to prohedonic, orientation should be associated with a momentarily more diminished working-memory capacity, that is, a diminished capacity for short-term storage and manipulation of information, even after controlling for the effects of momentary positive and negative affect (Riediger, Wrzus, Schmiedek, Wagner, & Lindenberger, in press).

To investigate these predictions, we used data from the first measurement phase of the MMAA Project. Among other things, participants had reported, on average 54 times throughout 3 weeks, how they momentarily felt and whether they currently wanted to dampen, enhance, or maintain each of six positive and negative affect facets (i.e., feeling angry, downcast, anxious, interested, joyful, and content). Participants further completed two trials of a numerical memory-updating task, assessing momentary working-memory capacity, on each measurement occasion.

Consistent with evidence from prior studies, we found an age-related increase in day-

to-day emotional well-being. Interestingly, these age differences largely corresponded to differences in how people wanted to influence their feelings (see Figure 3). Specifically, contra-hedonic orientations to enhance or maintain negative affect, or to dampen positive affect, were most prevalent among adolescents and decreased thereafter. Prohedonic orientation, in contrast, was most prevalent in later adulthood, and this effect was driven by the motivations to maintain (but not to enhance) positive, and to dampen negative affect. Importantly, the age differences in prohedonic and contra-hedonic orientation could not be attributed to age-related differences in daily-life emotional experiences, activities, or social partners. Instead, they suggest that part of the negative emotionality that is characteristic for adolescence, and part of the positive emotionality that is characteristic for older adulthood, might be intentionally sought and maintained by the individual. As expected, contra-hedonic orientations did not occur frequently in the daily lives of most participants. Across the entire sample, they were reported, on average, in 15% of

the measurement occasions and were thus considerably less prevalent than prohedonic orientations, which were reported, on average, in 92 % of the measurement occasions. The relatively high prevalence of contra-hedonic orientation in adolescents (about 25 % of the measurement occasions) nurtures the speculation that contra-hedonic orientation plays a role in adolescents' socioemotional development. Repudiating prevailing hedonic conventions may help adolescents to tackle developmental tasks they face, for example, to establish emotional autonomy from their parents, affirm a sense of maturity, and develop their personal and social identity. Contra-hedonic motivation may also help adolescents in the refinement of self-regulation competencies.

The mechanisms driving the higher prevalence of contra-hedonic motivations in adolescence remain to be explored. In the currently ongoing fourth measurement phase of the MMAA Project, we investigate potential linkages to explicit and implicit attitudes toward the valence and utility of affective states, to social norms among peers, as well as to puberty-related biological changes.

Irrespective of participants' age, findings regarding within-person associations between prohedonic and contra-hedonic orientations and within-person fluctuations in working-memory capacity were in line with the view that contra-hedonic orientations come at a cost (Riediger, Wrzus et al., in press). While prohedonic orientation was only weakly associated with within-person fluctuations in working-memory performance, the association of contra-hedonic orientation and working-memory performance was substantially more pronounced: The more contra-hedonic orientation participants reported, the lower their momentary working-memory performance was, and this was independent of the participants' momentary affective experience (see Figure 4). With a model-predicted decrement of about 23 % in working-memory performance from situations without, to situations with maximum contra-hedonic orientation, the effect of contra-hedonic orientation on working-memory performance was about 10 times larger than that of pro-

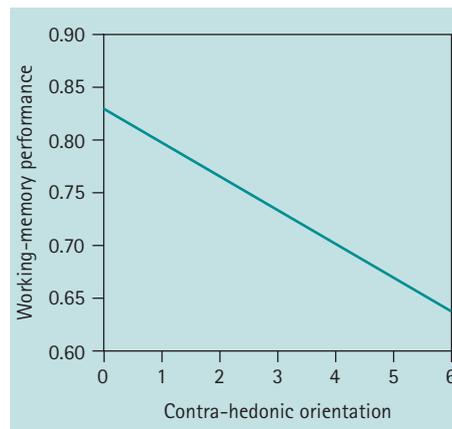


Figure 4. Associations of contra-hedonic orientation and working-memory performance in day-to-day life. The more contra-hedonic orientation participants reported, the lower was their working-memory capacity. Model predictions from multilevel regressions controlling for positive and negative affect, prohedonic orientation, and session number.

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hedonic orientation. These results demonstrated that occurrences of contra-hedonic orientation were associated with within-person fluctuations in momentary working-memory performance. In addition, participants who reported more contra-hedonic orientation on average showed lower average working-memory performance across all measurement occasions, which may partly reflect the aggregated effect of momentary occurrences of contra-hedonic orientation. Average prohedonic orientation, in contrast, was not significantly related to between-person differences in average working-memory performance. These findings were stable after controlling for participants' age and perceptual-motor speed, as well as for time of day, momentary activity, presence of social partners, and for trend-related effects, in addition to momentary positive and negative affect. Furthermore, the reductions in working-memory performance accompanying contra-hedonic orientation were not merely due to participants not working adequately on the task. Instead, the negative effects of contra-hedonic orientation on momentary working-memory capacity were also evident when only performance ranges that required meticulous effort to solve the task were taken into consider-

ation. The effects of contra-hedonic orientation on working-memory performance could thus not be attributed to lack of effort or to differences in other individual or situational characteristics. Rather, they are consistent with the idea that contra-hedonic orientation is more strongly associated with momentary decrements in available working-memory capacity than prohedonic orientation. Overall, our analyses demonstrate that taking into account motivational aspects of how people want to influence their feelings contributes to our understanding of age-related differences in affective functioning from adolescence to old age. So far, we have focused on consciously accessible aspects of affect-regulation orientations. In the currently ongoing fourth longitudinal assessment phase of the MMAA Project, we additionally implement an experimental approach to assess affect-regulation orientations operating beyond conscious awareness, using implicit association tests. Furthermore, assessments of hormonal processes will allow determining the role of puberty-related biological changes for characteristics of affective functioning in adolescence. In addition, longitudinal analyses are currently under way to investigate whether the cross-sectional age differences observed so far correspond to intraindividual changes as people grow older and to explore the antecedents, correlates, and consequences of interindividual differences in these changes.

Research Example 2: Age Differences in Affective Reactivity—Situation Matters

Another area of investigation within the MMAA Project refers to age-related differences in people's reactivity to negative experiences. Reactions to emotional events can occur in multiple domains of functioning. They can be reflected in changes in people's affective states (e.g., from feeling relaxed to feeling angry), changes in their outward behaviors (e.g., from smiling to frowning), as well as in changes in their autonomic activation (e.g., from higher to lower heart-rate variability).

Various theoretical positions regarding age-related differences in affective reactiv-

ity to emotion-eliciting events are currently discussed. Some researchers argue that emotional reactivity should increase with age throughout adulthood because age-related declines in fluid-cognitive capacity diminish people's ability to regulate their affective experiences in the face of adversity. Other researchers hold the contrary position and claim that emotional reactivity should decrease throughout adulthood because life experience and higher motivation to maximize emotional well-being lead to improved ability to control affective reactions to adverse experiences. Empirical evidence on age differences in emotional reactivity is also mixed and ranges from less to more reactivity to negative events among older as compared to younger adults. Proceeding from the observation that previous empirical studies differed considerably in the nature of the affect-eliciting event under investigation, we derived the *overpowering hypothesis* as a possible explanation for the inconclusive empirical picture that might bridge the apparently opposing theoretical stances. Our central assumption was that adult age differences in emotional reactivity depend on the characteristics of the affect-eliciting event. More specifically, we expected that age differences in emotional reactivity become particularly evident in highly resource-demanding situations that overtax older adults' capacity. In such situations, we expected older adults to react more strongly to adverse events than younger individuals because of insufficient availability of the cognitive resources necessary to successfully control affective responses. When resource demands are low, however, we predicted no age differences or even an age-related decrease in affective responsiveness to negative experiences, due, for example, to age-related increases in the motivation to feel good.

To account for the multidimensionality of affective responses, we investigated the overpowering hypothesis in terms of both psychological and physiological reactivity to adverse events (i.e., in terms of changes in both negative affect and heart-rate variability) using data from the first and second assessment phases of the MMAA Project. In

the first measurement phase, 378 participants aged 14 to 86 years reported, among other things and on average 54 times throughout 3 weeks, their momentary negative affect and whether adverse events had occurred in the preceding hours. On average eight and a half months later, a subsample of 92 participants wore an ambulatory biomonitoring system that continuously recorded, among other things, their cardiovascular activity over 24 hours while they pursued their normal daily routines. Participants additionally provided an average of seven experience samples, which again included reports of momentary negative affect and of occurrences of adverse situations.

In the first measurement phase of the MMAA Project, participants reported occurrences of adverse events in, on average, 9% of the measurement occasions. Most of these negative events affected other persons (39%), followed by events affecting work (14%), daily routines (10%), health (8%), or finances (6%). Adverse experiences that affect multiple life domains are more complex to deal with than situations with more circumscribed effects. We therefore used the number of life domains affected by a negative event as a proxy for the complexity of resource requirements imposed by the experience. Fifteen percent of the reported adverse events were classified as complex events accordingly. The prevalence of complex events did not differ significantly for people of different ages. The results regarding both psychological and physiological responding to negative events supported the overpowering hypothesis: When dealing with *complex* adverse events, both psychological and cardiovascular reactions were more pronounced the older the participants were. That is, the older the participants, the more their negative affect increased (see Figure 5) and the more their heart-rate variability decreased (indicating greater stress) in response to complex adverse events. Regarding negative events with *circumscribed* effects, in contrast, no age differences in psychological reactivity were observed, and physiological reactivity was even less pronounced the older the participants were.

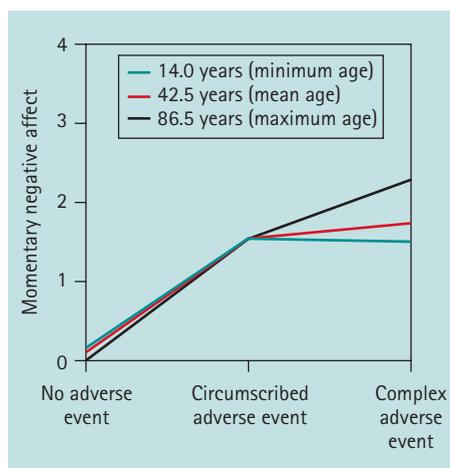


Figure 5. Age differences in affective reactivity to adverse events depend on the complexity of the situation. Several times a day throughout 3 weeks, participants reported the occurrence of adverse events and their momentary negative affect. After circumscribed adverse events, which concerned one life domain only, elevation of negative affect (relative to situations without preceding adverse events) was comparable for individuals from different age groups. After complex adverse events, however, which affected multiple life domains, elevation of negative affect was related to participants' age: The older participants were, the more their negative affect was elevated after complex adverse events. A similar pattern of findings was observed for participants' *physiological* reactivity to circumscribed and complex adverse events.

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These findings have several implications for better understanding how individuals from various age groups handle adverse experiences. Our findings are consistent with the notion of preserved or even increased affect regulation throughout adulthood, as long as the resource demands implied by the event do not overtax the individual's capacity. This interpretation is based on the findings of no age differences in psychological reactivity and of even less pronounced physiological reactivity to *circumscribed* adverse events. The findings of age-related increases in psychological and physiological responding to *complex* events that affect multiple life domains, however, are in line with the overpowering hypothesis. It suggests that, when the resource demands of an adverse situation exceed the cognitive capacity available, effective affect regulation is impaired and stronger affective reactivity results.

Outlook: Ongoing and Future Research on Age Differences in Affect Dynamics

A major emphasis in our ongoing and future research will be to further analyze, also in collaboration with other researchers at the MPI for Human Development, the rich longitudinal data set of the MMAA Project. These analyses will address a variety of research questions regarding age-related differences in affective processes and in respective within-person changes over time, regarding their associations with cognitive, motivational, and physiological processes.

For example, we currently extend our investigations on cross-sectional age differences in emotional reactivity by focusing on within-person change in affective reactivity over the course of 3 years. Furthermore, we scrutinize the time course of participants' affective and physiological reactivity to, and recovery from, adverse events as well as age-related differences therein. Together with results on the respective role of age-related differences in hormonal processes, which are currently assessed in the fourth assessment wave of the MMAA Project, these results will help us to disentangle effects of age-related differences in affect-regulation competencies from differences in biological processes related to affective experience and affective reactivity.

We also plan new data collections to extend our research on age-differences in affect dynamics. For example, we plan to focus more specifically on the age range from late childhood to early adulthood in future studies because we want to better understand some of the phenomena in adolescents' affective functioning that we have observed so far in the MMAA Project. When comparing adolescents to adults of different age groups, we found adolescent peaks in contra-hedonic orientations (of intentionally seeking negative affective experiences) in the prevalence of mixed feelings or in the variability of affective states. In the future, we plan to investigate the reasons, mechanisms, and functions of these adolescent phenomena. For example, Kathrin Klipker aims at disentangling, in her dissertation project, the roles that biological, social, motivational, and cognitive processes

play in contributing to enhanced emotional variability in adolescence.

Research Emphasis 2: Age-Related Differences in Affective Competencies

The second emphasis of our research is on age-related differences in abilities related to understanding and managing emotional aspects of life. In 2009 and 2010, we focused much of our respective work on processes related to *affect communication*. Here, we are interested in both how affective experiences are expressed by individuals of different age groups and in how these expressions are recognized by other people varying in age. While empirical evidence on age-related differences in affect expressions is still rare, several investigations are available that suggest that the ability to read other people's affective expressions *declines* with age throughout adulthood. The reasons for this apparent age-related decline, however, are not yet well understood. Surprisingly, age-related declines in fluid-cognitive functioning and face perception could not account for these findings. Furthermore, and perhaps even more importantly, these findings are also insofar surprising as they do not seem to translate into social difficulties in older adults' daily lives. On the contrary, evidence suggests that socioemotional functioning remains stable and may even improve throughout adulthood. To date, adult age differences in the ability to identify affective expressions have most frequently been investigated using photographs of faces of persons posing prototypical expressions of highly intense emotions. This "traditional" paradigm has two important methodological shortcomings that we sought to address in several recent studies. One limitation is a *lacking age fairness* of most studies, which used expressions of younger or middle-aged, but not older, adults as stimulus material. The second concern pertains to the fact that the traditional paradigm is quite different from affect-recognition demands in daily-life contexts and thus lacks *ecological validity*.

Below, we elucidate three of our recent empirical attempts to address these concerns. We first describe a study that focused on the

age-fairness issue by investigating whether age-related differences in the interpretation of emotional poses are moderated by the age of the posing persons. Thereafter, we sketch out a series of studies that attempted to enhance ecological validity by investigating age-related differences in identifying different types of smiles. The third approach incorporated dyadic experience sampling to investigate emotion communication in the daily-life contexts of younger and older romantic partners.

Research Example 3: Age Differences in Reading Emotional Faces—Does the Age of the Poser Matter?

Empirical evidence suggests that people are better at interpreting emotional expressions of individuals who are similar to themselves as opposed to individuals who are dissimilar. This has been shown for similarity in terms of sharing the same interests, nationality, ethnicity, cultural group, or university affiliation. Several mechanisms to explain these in-group effects have been proposed, such as a better knowledge base for interpreting facial expressions conveyed by individuals belonging to a group with which one self-identifies or a higher motivation to attend to and process the expressions of such individuals. It stands to reason that age-group membership may have similar effects. In studies that asked participants from various adult age groups to interpret facial expressions from young or middle-aged posers only, older adults might hence have been put at a disadvantage. Systematic investigations of this possibility were long not possible due to the lack of stimulus material that systematically varied the age of the persons showing emotional expressions. To overcome this void of suitable stimulus material, an extensive new data set, the FACES Lifespan Database of Facial Expressions, was developed in the Center for Lifespan Psychology (Ebner, Riediger, & Lindenberger, 2010). The FACES database contains 2,052 prototypic expressions of neutrality, anger, fear, sadness, disgust, and happiness, posed by 171 young, middle-aged, and older adults. It is thus unique in providing a large age range of individuals showing

different facial expressions (see Figure 6). In collaboration with Ursula Flitner (Head of the Library and Research Information Unit of the MPI for Human Development) and the eSciDoc project of the Max Planck Digital Library, an online tool was launched in 2009 to make the FACES database internationally available for research purposes (<http://faces.mpib-berlin.mpg.de>). Since then, more than 100 research groups from various countries have requested access to the FACES database. We used the FACES database in a sample of 154 raters to investigate, among other things, whether apparent adult age differences in correctly identifying emotional expressions disappear when interpreting expressions posed by older adults (Riediger, Voelkle, Ebner, & Lindenberger, in press). Results did not confirm this prediction. Young adults continued to be most accurate in identifying emotional expressions, even when these were posed by middle-aged or older adults. Nevertheless, this study demonstrated that a biased impression of age-related differences in emotion identification accrues if only expressions from young adults, but not from other age groups, are taken into consideration: Overall, emotional expressions were more difficult to identify the older the posers were. Some of these age-of-poser effects, however, differed across age groups of raters. Specifically, we found that, for neutrality, happiness, and anger, differences between age groups of raters would have been overestimated if only expressions from young, but not middle-age and older, posers were considered and that they would have been underestimated in the case of sadness (Riediger, Voelkle et al., in press). Taken together, this study indicates that lacking age fairness in previous studies could not fully account for the observed adult age differences in the ability to identify emotional expressions. It also shows, however, that taking into account the age of both poser and perceiver contributes to a better understanding of age-related differences in interpreting emotional pose.

Another line of our research aimed at addressing the concern that the traditional paradigm is of limited ecological validity. Posed expressions used in the traditional paradigm

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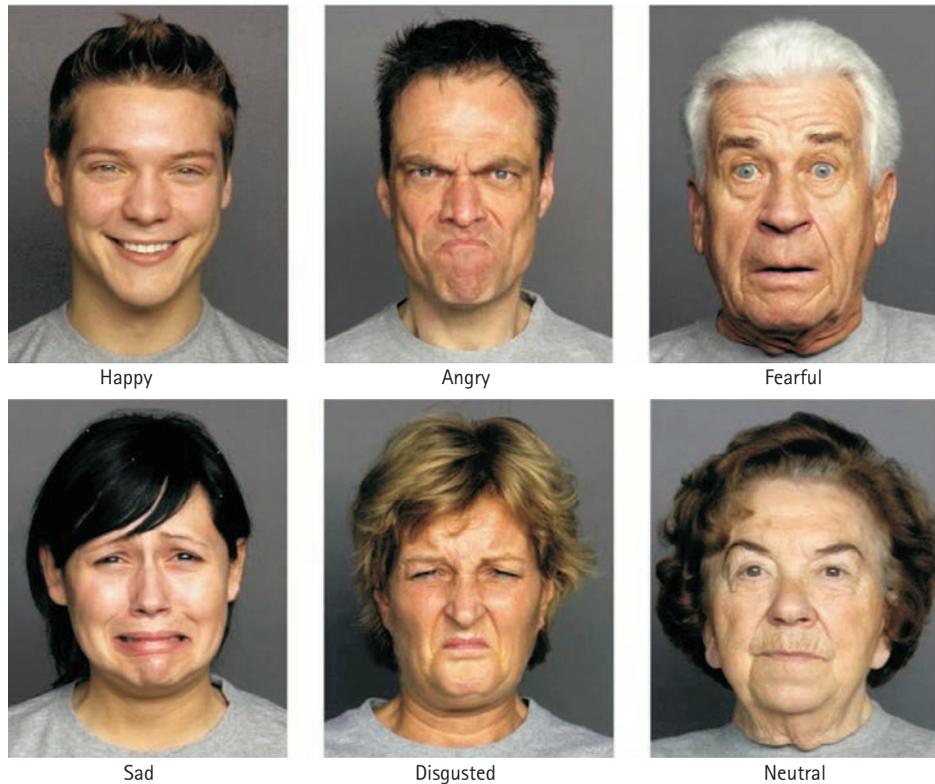


Figure 6. Sample expressions from the FACES Lifespan Database of Facial Expressions. FACES contains 2,052 photographs of facial expressions from 171 young, middle-aged, and older men and women. For each depicted person, the database provides two sets of six pictures each showing five emotional and one neutral expression. The unique feature of this database is that it systematically varies emotional expressions within persons stemming from different age groups.

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are highly intense and involve prototypical combinations of facial-muscle contractions. Spontaneous expressions of emotional experiences, however, are typically subtler in intensity and often involve less intense or other facial-muscle contractions than posed expressions. Furthermore, static posed expressions lack the cue-rich dynamic information that is available in real-life interactions. In the following sections, we describe two different approaches we have taken to enhance the ecological validity of our research.

Research Example 4: No Smile Like Another—Adult Age Differences in Reading Smiles

Our first approach toward enhancing ecological validity involved *smiles* instead of posed expressions of intense basic emotions. 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 were interested in whether younger and older adults differ in how well they are able to identify different emotional experiences accompanying smiles. Based on the assumption that interpreting different types of smiles is a more ecologically valid task than interpreting posed facial expressions in the traditional

paradigm, and as such allows older adults to draw on their accumulated experiences in understanding other people's expressions, we expected a performance advantage of older as compared to younger adults in understanding smile expressions.

To investigate this prediction, we produced videos of positive, negative, and nonemotional smiles. Positive and nonemotional smiles were elicited from 42 younger (20–30 years of age) and 48 older adults (70–80 years of age). Positive smiles were spontaneously shown while watching amusing video clips and cartoons. Nonemotional smiles were elicited by asking participants to smile. Together, more than 2,000 smile episodes were videotaped. Participants reported their feelings for each of these episodes. We selected positive smiles that had been accompanied by intense amusement and no other feelings, and nonemotional smile episodes that had not been accompanied by particular emotions. In addition, we extracted negative smile episodes from video footage of young adults being the target of unfair accusations during an experiment conducted by Weber and Wiedig-Allison at the University of Greifswald. These negative smiles had been accompanied by intense anger or other negative emotions.

In a first study, we presented 48 smile videos (16 per category, all of younger adults) to 48 younger (20–30 years of age) and 52 older (70–80 years of age) participants. Additionally, still pictures from the apex of each smile were presented to test the value of dynamic information for identifying emotional experiences. Participants were asked to indicate which emotional experience they thought had accompanied the smile (positive feelings, negative feelings, or no particularly intense feelings).

Contrary to our predictions, older adults' emotion-recognition accuracy did not profit from the more ecologically valid smile paradigm. As in the traditional paradigm, younger adults were more accurate in identifying emotional experiences accompanying smiles than older adults (see Figure 7). In fact, older adults' recognition accuracy for positive and negative smile videos was not better than chance. Furthermore, older adults were less

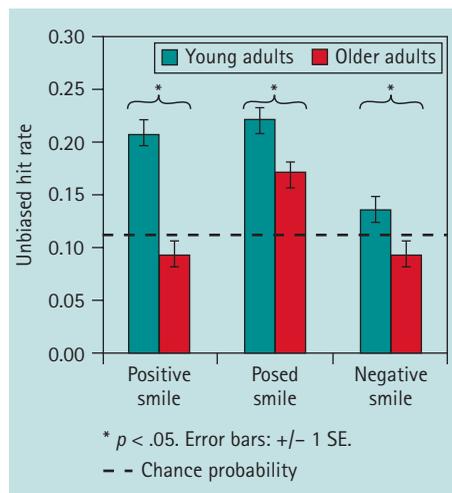


Figure 7. Younger adults are better in reading smiles than older adults. Younger adults were more accurate than older adults in identifying emotional experiences accompanying positive, nonemotional, and negative smiles.

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likely to attribute positive emotions to smiles, but more likely to assume that a given smile was posed, than younger adults. This finding was unexpected as it is not in line with theoretical claims that older adults are more motivated to attend to, and process, positive information. In addition, emotional experiences accompanying smiles were easier to identify from video than from picture stimuli. This indicates the importance of dynamic cues for understanding other people's emotional experiences.

In a second study, we investigated whether older adults' accuracy in reading smiles profits when the smiling persons stem from their own as compared to a younger age group. We presented positive and nonemotional smiles of younger and older adults to 48 young (20–30 years of age) and 49 older (70–80 years of age) participants. Results indeed confirmed an own-age advantage for older (but not younger) participants: Older participants could identify the accompanying emotional states best when the smiling persons were older adults as well. Although this selective gain in recognition accuracy attenuated the performance difference between younger and older participants when reading older adults' smiles, the overall pattern of age

Key References

Rauers, A., Riediger, M., Schmiedek, F., & Lindenberger, U. (in press). With a little help from my spouse: Does spousal collaboration compensate for the effects of cognitive aging? *Gerontology*. doi: 10.1159/000317335

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differences remained. Even when the smiling persons were older adults, younger adults' accuracy of identifying emotional experiences accompanying smiles was higher than that of older adults. This replicates the findings from our earlier studies.

Our ongoing analyses address the mechanisms underlying age-related differences in interpreting smiles. For example, we investigate whether younger and older participants differed in the morphological and dynamic smile characteristics they used as cues for deriving interpretations of the emotional experiences accompanying smiles. Taken together, this line of research replicated that younger adults attribute affective states more accurately to emotional expressions than older adults, even after enhancing the ecological validity compared to the previously used traditional paradigm. Also the smiles paradigm, however, differs from affect-recognition demands people encounter in their daily lives. It employs isolated and monosensory cues, while emotional information in everyday life is often multisensory and embedded in a communicatory context. Based on these considerations, another of our attempts toward enhancing ecological validity involved the use of dyadic experience sampling to assess age-related differences in empathic skills in people's natural living environments, as described next.

Research Example 5: I Know How You Feel—Emotion Communication in Younger and Older Couples' Daily Lives

When trying to understand another person's feelings, people are likely not only to draw on facial cues, but to use additional sensory information, such as verbal or prosodic cues, as well. Furthermore, interpretations of other people's feelings may be derived from one's knowledge regarding the emotional implications of a given situational context in addition to available sensory information. Research suggests that acquired knowledge may especially support older adults' emotion-recognition performance, whereas sensory information may be more useful for younger adults. Context-poor emotion-recognition paradigms may thus disadvantage older

adults in particular and lead to underestimating older adults' daily-life competencies.

To investigate this, we used dyadic experience sampling as a means to assess emotion understanding in younger and older couple's daily-life contexts, thus extending our earlier studies on mutual understanding among romantic partners of various age groups (Rauers, Riediger, Schmiedek, & Lindenberger, in press; Riediger & Rauers, 2010). We hypothesized that age differences in people's ability to infer their partner's current emotional state would depend on contextual factors, particularly the momentary absence or presence of the partner. When their partner is absent, people's ideas about their partner's current emotional states are exclusively based on acquired knowledge about the partner. This includes, for example, knowledge about the partner's usual mood at the time of the day and his or her typical mood while engaging in a specific activity or being at a particular place. We assumed that such mutual knowledge would not differ for younger and older couples. In contrast, when the partner is present, relevant sensory information is available in addition to knowledge about one's partner. Sensory-information processing has been shown to decline with age. We therefore assumed that, in the presence of their partners, younger adults would be more accurate than older adults in knowing their partners' momentary affective states. We expected no such age-related differences, however, in the absence of their partners.

We used the mobile-phone based experience-sampling technology developed in the MMAA Project in a sample of 50 younger adults (20–30 years of age) and 50 older (70–80 years of age) cohabitating heterosexual couples to investigate these predictions. Together, the sample thus comprised 200 individuals. Participants provided on average 87 experiences samples while pursuing their normal daily routines. Measurement occasions for cohabitating partners were scheduled simultaneously. Among other questions, participants were asked to report their own and their partner's momentary affective experiences regarding four positive and four negative affect facets (happy, enthusiastic, balanced, content, angry,

downcast, disappointed, and anxious). Correspondence between participants' rating of their partners' affective states and the respective partners' rating of their own affective states was used as an indicator of participants' insight into their partners' momentary subjective experience.

Consistent with our assumptions, younger adults rated their partners' affective states more accurately than older adults when the respective partner was present. There were no age differences, however, when the partners were apart (see Figure 8). Reaction time analyses indicate that this pattern was not due to younger couples coordinating their responses in the presence of their partners. Taken together, this study lends further support for age-related differences in emotion recognition, but provides a more differentiated picture. It replicates previous findings that younger adults are more accurate than older adults when inferring others' emotional experiences based on verbal or nonverbal sensory cues, such as facial or vocal expressions. However, there was no evidence of differences between younger and older adults' accuracy in identifying their partners' current emotional state when they relied exclusively on their knowledge about their partner. Notably, both younger and older adults knew their partners' affective states better than chance, even when the partner was absent. This suggests that sensory information is not a necessary prerequisite for inferring other people's feelings. Instead, nonsensory information (e.g., knowledge about the emotional implications of a given situational context) may be helpful for telling how a person feels. Relying on acquired knowledge in everyday-life situations may thus be a compensatory means in older adults' emotion communication.

Outlook: Ongoing and Future Research on Age Differences in Affective Competencies

So far, we have taken several methodological approaches to enhance the age-fairness and ecological validity when investigating adult age differences in the ability to understand other people's emotional experiences. Across these various methods, our data show that,

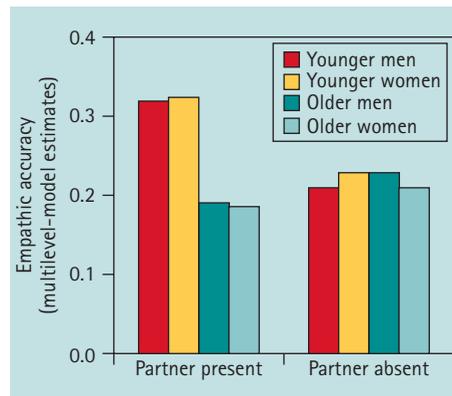


Figure 8. Differences between younger and older adults' knowledge of their partner's affect depend on the presence or absence of the partner. Experience-sampling data were obtained from cohabitating couples' daily lives. Participants simultaneously rated their own and their partner's current affect. Bars show multilevel-model estimates of the correspondence of self and partner reports, separately for younger and older men and women. Higher bars indicate better knowledge of the partner's emotional states across all measurement occasions. Younger adults were more accurate in rating their partner's current affect when the partner was present. When the partner was not present, however, younger and older adults' accuracy in rating their partner's affect was comparable, and both age groups' ratings were better than chance. This suggests that, apart from sensory information, acquired knowledge about the partner's emotional life may be informative when estimating how another person is feeling. Importantly, this knowledge base seems to be just as helpful for older adults as it is for younger adults.

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overall, younger adults are more accurate in reading others' emotions than older adults. There are, however, exceptions. While older adults are less able to read sensory cues, such as facial expressions, they seem to be as good as younger adults in deriving judgments about a close social partner's emotional experiences based on their acquired knowledge. In our ongoing research, we plan to investigate possible reasons for, and moderating factors of, these age-related differences in emotion recognition. For example, we plan to address the question of whether the observed cross-sectional differences between age groups reflect cohort differences or generalize to within-person changes over time. In particular, historical changes in display rules of emotional expressions might contribute to differences in emotional communication of

younger and older adults observed today. In an ongoing research endeavor, we currently explore this possibility, focusing particularly on age-related differences in the communicatory function of expressions of disgust. Another important task for our future research involves the investigation of the implications that adult age differences in emotion recognition have in people's social lives, for instance, regarding the quality of their social relations. Furthermore, we will broaden our approach beyond the perceivers' decoding skills by placing more emphasis on the role of the sender, that is, on the person who experiences and expresses emotional states. Although past research suggests that younger and older adults differ in how they pose emotional expressions, little is known to date about adult age differences in spontaneous emotional expressions.

We plan to experimentally elicit emotional experiences in younger and older adults, and to analyze potential age-related differences in how these emotional experiences are spontaneously expressed, and in how characteristics of the emotional expression influence other peoples' emotion-recognition accuracy for these expressions.

In collaboration with Katja Liebal and others from the *Languages of Emotions Cluster of Excellence*, we currently also extend our research toward investigating the question of whether age group differences in understanding other people's emotional expressions observed in Western cultures are also evident in a relatively isolated group of hunter-gatherers in Namibia, the #Akhoe Hai//om. Here, we modify and extend our research paradigms for application in cross-cultural investigations.

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(last update: February 2011)

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Max Planck Research Group

Felt Communities?

Emotions in European Music
Performances

Max Planck Research Group

The Max Planck Research Group "Felt Communities? Emotions in European Music Performances" (Head: Sven Oliver Müller) investigates 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 Research Group aims to decipher the emotional structure of communities: What role did and does music play in the development and cohesion of communities? The focus is less on the physiological effects of music than on how they are appropriated by groups. Musical performances have the power to connect diverse individuals within a community—or to create social and political enemies. The Research Group aims to analyze the historical patterns and contexts of these effects. The group began its work in 2010.



Research Staff 2009–2010

Sven Oliver Müller, Sarah Zalfen

Predoctoral Fellows

Tim Biermann, Anabelle Spallek, Henning Wellmann

Introductory Overview

Why should history be concerned with emotions and, moreover, with emotions in the musical life of Europe? The research group consisting of four predoctoral, one postdoctoral fellow, and one research assistant aims to shed light on the historical development of trained emotions and to decrypt the emotional structure of communities. The research group is working with the category “musically motivated emotions,” that is, they examine emotions as a form of public communication. The focus is on the social appropriation of music, rather than its physiological stimuli. Music lovers recognize each other by experiencing emotions as a group.

The appropriation of music bonds different people into a community—politically, socially, and economically. This is possible because music has a high emotional recognition. The qualities of music allow for the decoding of messages related to emotional states difficult to be communicated through language. Emotions triggered by music can bring people closer, they enable communication on a deeper level. The knowledge of styles, singers, and music groups is related to authority, as it determines who is educated, who belongs to the “knowing group”—and who does not.

For the research group, a historical and sociological approach is important: How did emotions motivate certain actions and how did they control behavior? What united music fans and what divided them? The predoctoral fellows examine to what extent “perceived communities” were formed through music performances. Through the repetition of

emotionally charged symbols, groups learned emotional bonds. By emotions here, we do not mean passing momentary sensations, but rather long-term behavioral patterns linked to social change. This means that the same songs could, in different contexts, often trigger different emotions. A change of historical perspective is necessary in order to understand the modulation of emotions. The research group will thus analyze music performances instead of musical stimuli, the impact of performances instead of the music itself.

The focus on modern Europe is certainly not representative of the entire historical world of music and emotions. It makes sense, however, for several reasons. The European music life in the 19th and 20th centuries needs to be considered within a time of political, economic, and cultural upheaval. The expansion of the public arena, the educational reforms, and the mass media opened up new learning paths for numerous people. The research group is studying how these factors led, on the one hand, to a convergence of emotions generated by music, but, on the other, to the emergence of social, national, and stylistic boundaries.

This can be observed in many places: in churches and street fairs, in dance clubs and on the radio, in 19th-century opera houses, and at pop concerts in the 20th century. The projects examine music performances in public places. Precisely due to the wide potential, the selected projects had to be limited. The topics of the PhD projects are:

- the media cult of Franz Liszt in Europe (1830–1850),
- the music policy of the Allies in Germany after the Second World War (1945–1949),
- the rise of the beat generation in the United Kingdom and Germany (1950–1970), and



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Source. istockphoto.de/DNY59.

- enthusiasm for, and the boycott of, the punk movement in Britain and Germany (1975–1995).

Projects

In order to decipher musically motivated emotions, the predoctoral research fellows are working on case studies that they themselves have selected. There are rarely extreme examples, instead frequent, even everyday practices are analyzed. Each dissertation is designed to examine a relevant emotional phenomenon. Can common or different emotional patterns be identified over the two centuries? Or was the music of the emotions subject to the current political context, social position, religion, or gender? The dissertations can be divided into three thematic groups: control attempts, loss of control, and the cult of genius.

Control attempts: Music performances are analyzed as deliberate efforts to control emotions. Attention is drawn to the mainstream views on the conduct of the public whose movements and expressions in church services and symphony concerts had to be disciplined. **Loss of control:** Various unrests in musical life as emotional strategies of minorities or youth cultures are case studies for doctoral dissertations. These were not just the products of spontaneous inspirations but also of emotions often expressed in the course of cultural interpretation disputes.

Cult of genius: The research fellows will investigate how geniuses earned their emotional importance not only through the reproduction of the music but also through their unique reception by the public. Maybe the new media created new forms of worship, perhaps the 20th-century pop stars embodied the cult of the 19th-century virtuoso. Did emotions render the boundaries between popular and distinctive taste in music more permeable?

The importance of music in European cultural history has made the assessment of emotions a key issue. Musically motivated emotions are hard to explain because they are easy to understand. But this is exactly why music lovers and historians alike have had so many choices.

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(last update: February 2011)

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This graduate program on the life course is part of the Max Planck Society's framework of International Max Planck Research Schools (IMPRS). It was established in 2002 as a collaboration between the Max Planck Institute for Human Development, Berlin, the Humboldt University Berlin (HU), the Free University Berlin (FU), and the University of Michigan, Ann Arbor. The University of Virginia, Charlottesville, joined in October 2004 and the University of Zurich followed suit in October 2008.

The goal of the Research School is advanced research training in the study of human behavior and institutional systems over evolutionary and ontogenetic (life cycle) time. LIFE takes an integrative and interdisciplinary approach to understanding human development in a changing world, connecting evolutionary, ontogenetic, historical, and institutional perspectives. A major aspect of this program is its internationality. On the one hand, this is achieved by recruiting students from all over the world to the Berlin-based group of fellows (e.g., Israel, Bulgaria, Azerbaijan, etc.). On the other hand, the four LIFE sites in three countries (Germany, USA, Switzerland) secure true international exchange by collaborating closely in the training of the fellows (see below). The target groups of the Research School are post-diploma or post-master's graduate

students who intend to pursue a doctorate in one of the relevant disciplines (biology, psychology, behavioral neuroscience, sociology, anthropology, educational science). As a collaborative Research School, LIFE offers students a unique education experience: Discipline-based training in the study of the life course/life cycle 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. Ten fellows (5 from Berlin, 2 from the University of Virginia, 1 from the University of Michigan, and 2 from the University of Zurich) have made use of the training-abroad option in 2009 and 2010.

Co-Chairs

Ulman Lindenberger,
MPI for Human
Development
Steven Boker,
University of Virginia
(as of 10/2010)
Alexandra M. Freund,
University of Zurich
John R. Nesselroade,
University of Virginia
(until 10/2010)
*Patricia A. Reuter-
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Imke Kruse, MPI for
Human Development
(until 6/2010)
Julia Delius, MPI for
Human Development
(as of 7/2010)
Deanna Maida, Uni-
versity of Michigan
Juanita L. Geer,
University of Virginia



Figure 1. Participants from all four LIFE sites during the LIFE Fall Academy 2010 at Schwanenwerder in Berlin.

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Figure 2. An attentive audience at the Fall Academy.

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The strong interlocking components are two annual weeklong academies in which fellows and faculty from each site participate. During the reporting period, four such academies

took place. The LIFE Spring Academy 2009 was organized by the University of Zurich and the Fall Academy 2009 took place at the University of Michigan. In 2010, the Spring Academy was held at the University of Virginia and the Fall Academy took place in Berlin and was organized by the MPI. Generally, the average number of participants including faculty was about 70. The teaching faculty consisted of faculty members from Ann Arbor, Berlin, Charlottesville, Zurich, as well as several guests from other institutions. The next Academy is scheduled to take place in Ann Arbor in May 2011. The IMPRS is currently funded until 2013.

In total, 78 faculty (Berlin: 27; Michigan: 27; Virginia: 15; Zurich: 9) and 69 fellows (Berlin: 27; Michigan: 14; Virginia: 13; Zurich: 15) were involved in the LIFE program at the end of 2010. In addition, 22 fellows (Berlin: 14; Michigan: 2; Virginia: 6) completed their dissertation during the reporting period.

Over the last years, fellows from all over the world have joined the program on the following annual schedule:

- 2009: 17 (Berlin: 6; Michigan: 5; Zurich: 6)
- 2010: 17 (Berlin: 11; Virginia: 4; Zurich: 3)

In addition to the Academies, each participating university offers special 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 offer weekly seminars at the MPI taught throughout the academic year by a diverse group of faculty from the three Berlin institutions as well as additional workshops, mainly on methods. Increasingly, courses are shared with the other LIFE sites via advanced video-conferencing technology (i. e., access grid).

Topics of the Berlin LIFE seminars in 2009 and 2010 were:

- *Activity and the Brain: Biological Concepts of Plasticity* (Workshop), Gerd Kempermann (Center for Regenerative Therapies [CRT] Dresden) & Martin Korte (University of Braunschweig)
- *Evolution of Conflict and Cooperation*, Peter Hammerstein (HU) and guests
- *Dynamical Systems Analysis*, Steven Boker (University of Virginia)
- *The Life Course: Different Perspectives on Learning*, Florian Schmiedek (HU), Matthias Grundmann (University of Munster), Björn Meder & Henrik Olsson (MPI), Oliver Wilhelm (Institute for Quality Development in Education, Berlin), Franziska Kopp (MPI), Werner Greve (University of Hildesheim), & Lars Penke (University of Edinburgh)
- *Lifespan and Plasticity*, Martin Lövdén (MPI), Sabine Schäfer (MPI), Silvia Bunge (University of California, Berkeley), Yee Lee Shing (MPI), Emrah Düzel (Otto-von-Guericke-University Magdeburg & University College London), Gerd Kempermann (CRT Dresden), Naftali Raz (Wayne State University), Hauke Heekeren (FU), Jaap Denissen (HU), Florian Schmiedek (German Institute for International Educational Research & MPI), Agnes Flöel (Charité), & Ulman Lindenberger (MPI)

MPI for Human Development

Jürgen Baumert, Educational Science
Gerd Gigerenzer, Psychology
Hauke Heekeren, Neuroscience (until 10/2010)
Shu-Chen Li, Psychology
Ulman Lindenberger, Psychology
Martin Lövdén, Psychology (since 2010)
Michaela Riediger, Psychology
Lael Schooler, Psychology

Free University Berlin

Michael Eid, Psychology
Hauke Heekeren, Neuroscience
Arthur M. Jacobs, Psychology
Herbert Scheithauer, Psychology
Ralf Schwarzer, Psychology & Health
Clemens Tesch-Römer, Psychology & Gerontology

Humboldt University Berlin

Jens B. Asendorpf, Psychology
Hans Bertram, Sociology
Jaap Denissen, Psychology
Peter A. Frensch, Psychology
Peter Hammerstein, Biology
Rainer H. Lehmann, Educational Science
Hans Anand Pant, Educational Science (since 2010)
Petra Stanat, Educational Science (since 2010)
Arno Villringer, Neuroscience

Other Faculty Affiliated with LIFE Berlin

Gerd Kempermann (Center for Regenerative Therapies Dresden), Neuroscience
Florian Schmiedek (German Institute for International Educational Research & MPI for Human Development), Psychology
C. Katharina Spieß (German Institute for Economic Research & Free University Berlin), Economics
Gert G. Wagner (German Institute for Economic Research & MPI for Human Development), Economics
Oliver Wilhelm (University of Duisburg-Essen), Psychology & Education

University of Michigan

Toni C. Antonucci, Psychology
Don Brown, Psychology
Kai S. Cortina, Psychology & Education

Pamela Davis-Kean, Psychology & Education (since 2010)
Jacquelynn S. Eccles, Psychology & Education
Robin S. Edelstein, Psychology
Richard Gonzalez, Psychology
L. Rowell Huesmann, Psychology & Communication Studies
James S. Jackson, Social Psychology
Daniel Keating, Psychology
Shinobu Kitayama, Psychology
Daniel Kruger, Psychology & Public Health
Bobbi S. Low, Evolutionary & Behavioral Ecology
Cindy Lustig, Psychology
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Judy DeLoache, Developmental Psychology
Chad Dodson, Cognitive Psychology
David L. Hill, Psychobiology
Vikram Jaswal, Developmental Psychology
Angeline Lillard, Developmental Psychology
John R. Nesselroade, Quantitative & Developmental Psychology
Brian Nosek, Cognitive, Quantitative, & Social Psychology
Robert C. Pianta, Educational Science
Timothy Salthouse, Cognitive Psychology
Bethany Teachman, Clinical & Social Psychology (since 2010)
Eric Turkheimer, Quantitative & Clinical Psychology
Timothy D. Wilson, Social Psychology
James H. Wyckoff, Educational Science

**LIFE Faculty
2009/2010
(as of December
2010)**

University of Zurich

Evelyn Bertin, General & Developmental Psychology
Simon Forstmeier, Psychopathology & Clinical Intervention
Alexandra M. Freund, Applied Psychology: Life-Management
Lutz Jäncke, Neuropsychology
Andreas Maercker, Psychopathology & Clinical Intervention
Mike Martin, Gerontopsychology
Bettina S. Wiese, Applied Psychology: Life-Management
Friedrich Wilkening, General & Developmental Psychology
Daniel Zimprich, Gerontopsychology

LIFE Doctoral Fellows 2009/2010 (as of December 2010)

MPI for Human Development

Cathleen Bache, Psychology
Yana Fandakova (External LIFE Fellow), Psychology
Kathrin Klipker, Psychology
Goran Papenberg (External LIFE Fellow), Psychology
Johanna Säinger (External LIFE Fellow), Psychology
Viola Störmer (External LIFE Fellow), Psychology
Elisabeth Wenger, Psychology

Free University Berlin

Eva Elliott, Psychology
Natalie Schüz (née Mallach), Psychology
Anja Schultze-Krumbholz, Psychology
Ralf Wölfer, Psychology

Humboldt University Berlin

Michael Dufner, Psychology
Fidan Gasimova, Mathematics
Tanja Gerlach, Psychology
Gizem Hülür, Psychology
Roos Hutteman (External LIFE Fellow), Psychology
Wiebke Neberich, Psychology
Anne Reitz, Psychology
Nicolas Schuck, Psychology
André Weinreich (External LIFE Fellow), Psychology

Other Institutions Affiliated with LIFE Berlin

Julia Freund (Center for Regenerative Therapies Dresden), Neuroscience
Fivos Iliopoulos (Berlin Neuroimaging Center, Charité), Neuroscience
Imke Kirste (Center for Regenerative Therapies Dresden), Neuroscience
Anita Kottwitz (German Institute for Economic Research), Sociology
Ina Schöllgen (German Centre of Gerontology), Psychology
Bettina Sonnenberg (German Institute for Economic Research), Sociology
Maja Wiest (German Centre of Gerontology), Psychology

University of Michigan

Jessica Bernard, Psychology
Joshua Carp, Psychology & Neuroscience
Rona Carter, Psychology
Daniel Choe, Psychology
Kristin Flegal, Psychology
Igor Grossmann, Psychology
Ashley Hazel, Anthropology
Leah H. Kokinakis, Psychology
Jonathan Lane, Psychology
Julie Maslowsky, Psychology
Scott McCann, Psychology
Nicky Newton, Psychology
Fernando Rodriguez, Psychology
Alvin Thomas, Psychology

University of Virginia

Christopher Beam, Psychology
Timothy R. Brick, Psychology
Ryne Estabrook, Psychology
Selin Kesebir, Psychology
Matthew Lerner, Psychology
Nicole Lindner, Psychology
Felicity F. Miao, Psychology
Jesse Pappas, Psychology
Jennifer Simpson, Psychology
Jeffrey R. Spies, Psychology
Amanda Steiner, Psychology & Neuroscience
Thomas Talhelm, Psychology
Elizabeth R. Tenney, Psychology

University of Zurich

Ladina Bezzola, Psychology
Miriam Depping, Psychology
Reinhard Drobetz, Psychology
Sonja Fankhauser, Psychology
Marie Hennecke, Psychology
Dalit Jäckel, Psychology
Kathrin Krause, Psychology
Regula Lehmann, Psychology
Anna Mascherek, Psychology
Florentina Mattli, Psychology
Wenke Möhring, Psychology
Moyra Mortby, Psychology
Maida Mustafic, Psychology
Barbara Preschl, Psychology
Simone Schaub, Psychology



Max Planck Research Network on Cognition (Maxnet Cognition)



The *substantive focus* of the **Max Planck Research Network on Cognition (Maxnet Cognition)** is on behavioral neuroscience of cognition, with an emphasis on one or more of the following: human cognitive performance, structural and functional brain circuitry, and computational algorithms. The Network is open to all institutes of the Max Planck Society and also includes cooperation partners from other research institutions. The Innovation Fund of the Max Planck Society has funded the Network for an initial period of 5 years (2009–2013).

The *strategic goals* of Maxnet Cognition are to: (a) increase cooperation and improve coordination between institutes and across sections, (b) promote research on cognition by providing a more cohesive representation of cognitive research issues and identifying future research directions, (c) foster cross-disciplinary insights and collaboration, and (d) signal the strong and sustained commitment of the Max Planck Society to the topic of cognition.

The *activities* of Maxnet Cognition include joint research activities as well as topical workshops on themes of common interest. The objectives of the workshops are to: (a) nurture interdisciplinary and multilevel discourse, (b) present research on cognition broadly but also in depth, (c) advance theories and new methodologies/paradigms, (d) open up new lines of inquiry into the study of cognition, and (e) plan collaborative research to be conducted at the home institutions. In 2009, two workshops were held, exploring potential research collaborations in the field of *Genetics and Cognition* and *Face Perception in Social Context*. As a result, these two emphasis topics were identified as research clusters covering several collaborative projects between institutes.

Collaboration within the *Genetics and Cognition* framework has focused on establishing a common measurement protocol across different research institutions inside and outside the Max Planck Society. The protocol is likely to include (a) functional magnetic resonance imaging (MRI) of the default network, (b) structural MRI of grey matter volume and white matter tracts, (c) key indicators of

cognitive functioning, (d) genetic information (candidate genes and, possibly, genome-wide association scans). By agreeing on this protocol, the participating institutions increase their potential for discovery and replication of relations among genes, brain, and behavior. The coordinator for this emphasis topic is Hubert Fonteijn from the MPI for Psycholinguistics at Nijmegen.

Research within the *Face Perception in Social Context* framework includes topics such as dynamic facial expressions, multisensory integration, action prediction, and development across the lifespan. In 2009 and 2010, scientists from the MPI for Biological Cybernetics, Tübingen, MPI for Human Cognitive and Brain Sciences, Leipzig, MPI for Human Development, Berlin, and MPI for Psycholinguistics, Nijmegen, were involved in these research activities. The coordinator for this emphasis topic is Franziska Kopp at the Center for Lifespan Psychology (see also the Center for Lifespan Psychology's project *Interactive Brains, Social Minds*, pp. 211–216).

Steering Committee

Peter Hagoort, MPI for Psycholinguistics, Nijmegen
Ulman Lindenberger, MPI for Human Development, Berlin
Arno Villringer, MPI for Human Cognitive and Brain Sciences, Leipzig



Service Units

Professional Staff (2009–2010)

Library and Research Information: Nicole Engelhardt, Ursula Flitner

Information Technology Center: Wolfgang Assmann

Library and Research Information

Rapid access to printed and digital information is a decisive prerequisite for successful studies and for internationally renowned research.

The Library and Research Information Unit of the Max Planck Institute for Human Development aims to anticipate, determine, and respond to the Institute's needs for information in the areas of education, history, sociology, psychology, 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 efficient and independent use and dissemination of information.

The Library's collection currently comprises around 200,000 volumes, 530 printed periodicals, several thousand electronic journals, and an extensive selection of electronic resources. It provides fast and easy access to our own materials and information worldwide. Comprehensive intranet services include online access to major bibliographic, abstract, and full-text databases, to portals and e-books, to document delivery services, and listings of new acquisitions. In 2009 and 2010, the range of electronic full texts available within the context of the Max Planck Society's basic provision (*Grundversorgung*) was expanded to include more than 17,000 journals from all fields of science, thus facilitating interdisciplinary research.

The collection of centrally and locally licensed electronic resources accessible from every desktop in the Institute is growing steadily. Electronic resources recently added to the Library's services include the following:

- *SCOPUS*: Elsevier's abstract and citation database for peer-reviewed literature can be seen as competing with Thomson Reuters' Web of Science.
- *Henry Stewart Talks—“Biomedical & Life Sciences Collection”*: A collection of over 800 specially prepared animated audiovisual presentations by leading scientists, including the Cognitive Neuroscience Series.
- *PsycNet*: The American Psychological Association's (APA) database platform includes databases such as PsycArticles and Psyc-Critiques.
- *Bibliography of Asian Studies (BAS)*: The online version of the BAS contains over 737,175 records on all subjects (especially in the humanities and the social sciences) pertaining to East, Southeast, and South

Asia published worldwide from 1971 to the present. Through to the 1991 printed version, the BAS included citations to Western-language periodical articles, monographs, chapters in edited volumes, conference proceedings, anthologies, and Festschriften.

- *ARTstor*: A digital library of nearly one million images in the areas of art, architecture, the humanities, and social sciences.
- *Kindlers Literaturlexikon*: The online version of the famous literary encyclopedia describes the most important works of fiction and non-fiction of the literatures of the world.

The Institute continues to profit from the National Licenses, a program financed by the German Research Foundation (DFG), offering free access on a national level to a vast number of databases, digital full-text collections, and e-journals. The Library staff offer regular training sessions in the use of these and other databases.

Another current focus is on developing the collection for the Center for the History of Emotions. The Library is continuing to build up a base of current and classical historical literature that was not previously systematically included in its collection.



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In 2010, the Library and Research Information Unit also embarked on a long-planned project: replacing its library system by a widely used, sustainable system that will ensure compliance with international standards. Most of the new tools—for example, the acquisition software—will run in the background and make no obvious difference to users. However, Library users will benefit from the change in various ways. Most notably, a new online catalog will be implemented, with several useful new functions that can be adjusted to individual needs. 2009 and 2010 also saw the development of two further projects:

- Within the framework of HARVE—the Humanities Archive of the Max Planck Society—the Library and Research Information Unit initiated the long-term preservation of video and audio material from two longitudinal family research studies conducted at the Institute in past decades: *Early Childhood Socialization within the Family* (ECSF; 1978–1983) and *Transition to Adolescence in the Family* (TAF; 1989–1994). More than 2,000 media files are currently undergoing digitization and metadata enrichment, thus ensuring the long-term preservation of the material and enabling scholars from various disciplines to access it.
 - In 2010, the *Digitization Lifecycle* project was approved by the Max Planck Society. This project aims to develop generic solutions for the setup, management, and presentation of digital libraries and their extension to virtual research environments for different scientific fields. Several Max Planck Institutes and the Max Planck Digital Library will cooperate closely in this project, which is part of the eSciDoc Initiative of the Max Planck Digital Library (MPDL) and is scheduled to begin in February 2011.
- In November 2010, the Library and Research Information Unit hosted the annual Fall Convention of librarians of the Humanities Section. Discussions over the two days covered topics including e-books, copyright and open access, and DARIAH, which provides a digital infrastructure for researchers in the arts and humanities in Europe. Last but not least, the Library continues to train apprentices in Library and Information Science.

Information Technology Center

The central facilities of the Information Technology/Processing Center support the individual research centers and other service units at the Institute.

For variable services, such as internet/intranet, the website, software, e-mail, etc., central servers with MS Windows, MacOS X, and Linux operating systems are installed in the Institute. Several powerful servers build a CITRIX server farm. They allow the user to run programs (SPSS, SAS, MAT-Lab, EQS, etc.) on the server CPUs from their own workstations (Windows or MacOS). "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 through the software VMware or XEN to realize a consolidation concept that will provide optimal pooling and distribution of resources.

The decentralized computing capacity comprises more than 500 personal computers. Apple computers operate with MacOS X; Intel PCs are operating on Microsoft Windows XP, Windows 7, 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 140 TByte storage capacity available to store data. A central backup service is provided on cluster disks for all data. To provide the necessary security, a Cisco-ASA firewall system is installed. Central virus scanner software Sophos—continuously updated via internet—monitors all server 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. In 1998, the traditional standard- and thin-wire Ethernet was replaced with a new network based on fiber optic cables. Since 2007, desktop systems are directly connected with a maximum speed of 1 Gbit/s.

A wireless LAN is available for users with mobile devices throughout the entire Institute. The Research Network (WIN) of German Telekom and the German Research Network Association (Deutsches Forschungsnetz [DFN]) provide the Institute's connections to Wide Area Networks (internet, etc.).

An important component of the new web appearance of the Institute is the CMS System Drupal. It allows many editors within the Institute to update and correct their web pages

at the same time. A staging system separates editorial content from public content.

The IT Center's services include:

- operating, optimizing, and developing the central server cluster and network equipment;
- updating and mending Windows and MacOS operating systems on workplace computers;
- availability of the centralized printing capacity, including high-speed and color printers;
- integration of workplace computers in the local area network and wireless LAN;
- making national and international connections (Wide Area Network) available;
- internet services;
- data storage and backup strategies;
- preventive security measures;
- management of the central telephone system, including the voice-mail server;
- user support and trouble-shooting for workplace computers and notebooks;
- software acquisition.



Figure 1. Central server room.

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Figure 2. Storage area network (SAN).

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The Center offers:

- general design and coordination of the Institute's information technology equipment;
- documentation of the Institute's existing computer and network inventory;
- an overview of market developments;
- advice for the Institute's research centers and board;
- development of new concepts for the Institute, for example, with WLAN, SAN, Access GRID, Computer and storage virtualization, etc.

Appendix





Last update: February 2011

1. Honors and Awards 2009–2010

Jürgen Baumert was awarded a Honorary Doctorate by the University of Tübingen. He was also appointed Honorary Professor by the University of Kiel.

Wolfgang Edelstein has been awarded the 2009 Hildegard Hamm-Brücher Prize for Learning and Experiencing Democracy.

Markus A. Feufel received the Human Factors and Ergonomics Society's 2010 Best Ergonomics in Design Article Award for the most outstanding article in the 2009 volume of *Ergonomics in Design*.

Ute Frevert became member of the Berlin-Brandenburg Academy of Sciences and Humanities.

Benno Gammerl received the Friedrich Meinecke Prize 2008 of the Friedrich Meinecke Institute of the Free University Berlin for his doctoral dissertation.

Gerd Gigerenzer received a Honorary Doctorate from the Open University of the Netherlands. He was also awarded the Marsilius Medal for interdisciplinary research and achievements in the dialogue between the scholarly cultures by the University of Heidelberg.

Uta Klusmann was awarded the "Dissertationspreis 2009 für pädagogische Psychologie" of the Deutsche Gesellschaft für Psychologie.

Ulman Lindenberger was awarded the Leibniz Prize 2010, the largest German research Prize. He was also elected to fellow status of the APA American Psychological Society.

Kai Maaz together with Gabriel Nagy was awarded the Ernst Meumann Young Investigator Award 2010 from the Working Group for Educational Research.

Julian N. Marewski has been granted a Reimar Lüst Fellowship of the Max Planck Society for his doctoral dissertation.

Marco Monti received the Award of the Italian Cooperative Banks for his Innovative Applied Research Project "The Cognitive Banking" on Shared Decision Making in Finance and also the Award of the Italian Health Care Provider for his Project "Words that care" on Doctor-Patient Communication.

Gabriel Nagy together with Kai Maaz was awarded the Ernst Meumann Young Investigator Award 2010 from the Working Group for Educational Research.

Margrit Pernau received the Geisteswissenschaften International Award—Translation Funding for Work in the Humanities and Social Sciences.

Max Wolf received the Reinhart Heinrich Doctoral Thesis Award of the European Society for Mathematical and Theoretical Biology.

Professorship Offers

Hauke R. Heekeren accepted the offer for a full professorship (W3) for "Affective Neuroscience and Psychology of Emotions" at the Free University Berlin.

Katrin Jonkmann accepted a junior professorship (W1) for Educational Science at the University of Tübingen.

Nele Julius-McElvany accepted a full professorship (W3) for Educational Science at the Technical University of Dortmund.

Uta Klusmann accepted a junior professorship (W1) for Educational Science at the University of Kiel.

Mareike Kunter accepted a full professorship (W3) for Educational Psychology at the University of Frankfurt a. M.

Kai Maaz was offered a full professorship (W3) for Educational Science at the University of Wuppertal and a full professorship (W3) for Educational Science at the University of Education, Freiburg. He accepted a full professorship (W3) of Quantitative Methods in Education at the University of Potsdam.

Gabriel Nagy was offered a junior professorship (W1) for Educational Science at the University of Tübingen.

2. Research Colloquia 2009–2010

Altenmüller, Eckart

University of Music, Drama and Media Hanover,
Germany
Sensory Motor Integration and Disintegration in
Highly Skilled Musicians: The Musician's Brain as a
Model for Neuroplasticity
20.10.2009

Bähr, Andreas

Free University Berlin, Germany
Die Furcht vor Gewalt und die Gewalt der Furcht im
17. Jahrhundert
18.05.2010

Bauhaus-Lötzke, Hannelore

Berlin, Germany
Bollywood-Film Colloquium: Pinjar (2003)
09.06.2009

Beckwitz, Andreas

European University Viadrina Frankfurt/O., Germany
Practices—Emotions—Spaces
22.07.2010

Benhabib, Seyla

Yale University, USA
Emotions in Hannah Arendt's Work
14.07.2009

Berg, Servaas van der

University of Stellenbosch and National Research
Foundation, South Africa
Educational Inequality in South Africa
12.06.2009

Boeva, Veselka

Technical University of Sofia, Bulgaria
Mathematical Models for Studying Group Decision
Making Scenarios
29.10.2009

Bröder, Arndt

University of Bonn, Germany
Signal Detection and Threshold Models of Recogni-
tion Memory and Source Monitoring
17.02.2010

Bruine de Brune, Wandi

Carnegie Mellon University, USA
Risk Perception and Risk Communication
25.03.2010

Buikstra, Arjon

University of Amsterdam, Netherlands
Finding the Right Answer in Complex, Large Scale
Knowledge
06.10.2010

Bunge, Silvia

University of California, Berkeley, USA
Reasoning Ability: Neural Mechanisms, Develop-
ment, and Training
13.02.2009

Büschel, Hubertus

University of Giessen, Germany
Shame and Colonial Remorse: Discourses of Power
in Colonial and Post-Colonial Development in Sub-
Saharan Africa
29.06.2010

Butko, Nicholas

University of California, San Diego, USA
Infomax and Eye Movement Control
26.03.2009

Cabeza, Roberto

Duke University, USA
Compensatory Brain Activity in Older Adults
15.07.2009

Chakrabarty, Dipesh

University of Chicago, USA
Research and Affect: Emotions Surrounding the
Search for Historical Sources in Maratha History,
Bombay Presidency ca. 1910–1950
02.06.2009

Chater, Nick

University College London, UK
The Instability of Utility
11.05.2009

Conradt, Larissa

University of Sussex, UK
Collective Decision Making in Animals
05.10.2010

Cortina, Kai S.

University of Michigan, USA
Comprehensive School Reform in the United States:
A Model for Germany?
22.04.2009

Crupi, Vincenzo

University of Trento, Italy
Subtleties of Human Inductive Reasoning: Proba-
bility, Confirmation and Information Search
24.02.2010

De Neys, Wim

CNRS, Université de Toulouse, France
Conflict Detection and Thinking: Do We Know We're
Biased?
17.03.2010

D'Esposito, Mark

University of California, Berkeley, USA
Cognitive Control, Aging and the Frontal Lobes
27.10.2009

Diamond, Adele

University of British Columbia, Canada
The Development of Executive Functions: Surprising
Ways in Which Children and Adults are Similar and
Different
19.10.2010

Edwards, Adrian

Cardiff University, School of Medicine, USA
Risk Communication & Shared Decision Making:
Illusion or Reality?
12.10.2010

Ehrig, Timo

MPI for Mathematics in the Science, Leipzig,
Germany
The Formation of Expectations for Novel Opportu-
nity
10.11.2010

Engelbrecht, Sascha

KPMG Berlin, Germany
Financial Risk Management. Theory, Practice, and
the Human Element
17.11.2010

Engelstein, Laura

Yale University, USA
Fear and the Jewish Question: Russia in World War I
16.11.2010

- Epstein, Robert**
University of California, Berkeley, USA
The Case Against Adolescence
02.03.2009
- Erdfelder, Edgar**
University of Mannheim, Germany
The Role of Heuristic and Analytic Processes in a Thematic Version of Wason's Selection Task
09.12.2009
- Fauser, Annegret**
University of North Carolina at Chapel Hill, USA
Harnessing Music's Emotional Power: Music as Therapy in the United States During World War II
04.05.2010
- Feltz, Adam**
Florida State University, USA
Experimental Philosophy: Building and Interdisciplinary Science
29.07.2009
- Fitzpatrick, Sheila**
University of Chicago, USA
Getting Personal: On Subjectivity in Historical Practice
05.05.2009
- Garcia-Retamero, Rocio**
University of Granada, Spain
Doc, What Would You do if You Were me? On Self-Other Discrepancies in Decision Making About Health
27.01.2010
- Glöckner, Andreas**
MPI for Research on Collective Goods, Bonn, Germany
The Parallel Constraint Satisfaction Approach to Judgement and Decision Making
06.05.2009
- Goel, Vinod**
York University, Toronto, Canada
Dissociating Small-World & Large-World Brains
28.10.2009
- Gosling, Sam**
University of Texas, USA
A Room With a Cue: Expression of Personality in Everyday Contexts; Discussion on Animal Personality
30.06.2010
- Grady, Cheryl L.**
University of Toronto, Canada
Do Age Differences in Resting Brain Activity Influence Activity During Cognitive Tasks?
17.06.2010
- Gräsel, Cornelia**
University of Wuppertal, Germany
Pädagogische Leistungsbeurteilung als sozial-kognitiven Prozess. Theoretische Konzepte und methodische Probleme
15.10.2009
- Green, Nile**
University of California, Los Angeles, USA
The Menu of Emotions: Reciprocal Dining Between Persia and England, 1800–1835
20.07.2010
- Grob, Alexander**
University of Basel, Switzerland
Intelligence and Development Scales? Konzept, Standardisierung und Validierung
20.01.2010
- Groebner, Valentin**
University of Luzern, Switzerland
Zeitreise zu den echten Gefühlen. Tourismus, third-person effects und der Gebrauch des Historischen
30.11.2010
- Grüne-Yanoff, Till**
Helsinki Collegium of Advanced Studies, Norway
The Prescriptive Implications of Behavioural Economics
20.01.2010
- Hahn, Ulrike**
Cardiff University, USA
What Makes Things Similar?
06.01.2010
- Hanoach, Yaniv**
University of Plymouth, UK
Prospect Theory Behind Bars
16.12.2009
- Harder, Hans**
University of Heidelberg, Germany
Ecstasy: Conventionalising Unconventional Emotional Sufism (With Special Reference to Bengal)
01.12.2009
- Hasher, Lynn**
University of Toronto, Canada
Age-Related Consequences of Attention Regulation and Dysregulation (Paul B. Baltes Lecture at the BBAW)
28.10.2009
- Hasselhorn, Marcus**
German Institute for International Educational Research, Germany
Acquisition and Maintenance of Individual Competencies as a Target of Education
02.10.2009
- Heckman, James**
University of Chicago, USA
Ways of Dealing With Imperfect Randomization; Methodological and Technical Problems in Longitudinal Studies (Harnack Haus)
17.03.2009
The Economics and Psychology of Inequality and Human Developments (Heilig-Geist-Kapelle, Humboldt University Berlin)
18.03.2009
- Hediger, Vinzenz**
University of Bochum, Germany
Beyond Horror: Kleine Kartographie der schlechten Gefühle im Film
02.11.2010
- Hertwig, Ralph**
University of Basel, Switzerland
Tools of Social Rationality
24.03.2010
- Herzog, Dagmar**
City University of New York, USA
What Role do Emotions Play in the History of Sexuality?
23.07.2010
- Hilbig, Benjamin**
University of Mannheim, Germany
Methodology Matters: On (Measuring) the Use of Fast-and-Frugal Heuristics
27.10.2010

- Hills, Thomas**
University of Basel, Switzerland
Search in Space and Mind: The Evolution of Generalized Cognitive Search Processes
27.04.2009
- Hippel, Bill von**
University of Queensland, USA
The Impact of Power, Attraction, and Testosterone on Risky Decision Making
11.03.2009
- Hugdahl, Kenneth**
University of Bergen, Norway
Cognitive Control as a Bottom-Up/Top-Down Processing Conflict
16.06.2010
- Illouz, Eva**
Hebrew University of Jerusalem, Israel (currently at Institute for Advanced Study, Berlin, Germany)
Emotions and Utopias of Happiness
17.02.2009
- Jay, Martin**
University of California, Berkeley, USA
From the Age of Reason to the Age of Reasons: Exploring the Limits of Rationality
19.10.2010
- Jirsa, Viktor**
University of Marseille, France; Florida Atlantic University, Boca Raton, USA
Noise Aids in the Exploration of the Brain's Dynamic Repertoire During Rest
28.04.2009
- Jung, Jacqueline**
Yale University, USA
The "Wise and Foolish Virgins" and the Spectacle of Emotion in Gothic Germany
21.04.2009
- Kämmer, Juliane**
Humboldt University Berlin, Germany
Heuristics for Group Decision Making
08.04.2009
- Kappesser, Judith**
University of Mainz, Germany
Estimating Another's Pain: Are We Asking the Right Questions?
04.02.2009
- Kaufman, Scott**
Yale University, USA
Intelligence, Reasoning, and Dual Systems
23.07.2009
Yale University, New York University, USA
Intelligence and Implicit Learning
17.03.2010
- King, Andrew**
University College London, UK
A Model of Group Decision Making in Baboons
31.03.2010
- Koedinger, Ken**
Carnegie Mellon University, USA
Big Science to Understand Learning and Improve Education: Building a Socio-Technical Research Infrastructure
23.03.2009
- Krause, Jens**
Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany
Collective Behaviour and Swarm Intelligence
10.03.2010
- Kruglanski, Arie**
University of Maryland, USA
On Parametric Continuities in the World of Binary Either Ors
21.04.2009
- Kübler, Dorothea**
Social Science Research Center Berlin, Germany
Why Votes Have a Value
08.09.2010
- Leimar, Olof**
Stockholm University, Sweden
Novelty, Saltation and the Evolution of Mimicry Rings
14.07.2010
- Leys, Ruth**
Johns Hopkins University, Baltimore, USA
Affect in Theory: History and Critique
25.05.2010
- Linke, Angelika**
University of Zurich, Switzerland
Grief, Happiness and the Construction of Social Relations. Changes in the Emotional Contextualization of Birth and Death From 1950 until Today
16.06.2010
- Lomash, Hitashi**
Thapar University, Patiala, India
Simon vs. Sen
25.05.2010
- Luan, Shenghua**
School of Social Sciences, Singapore University, Singapore
Estimation Without Integration: How Humans Learn and Use Correlated Cues
10.06.2009
- Marsh, Barnaby**
John Templeton Foundation, USA
Simple Heuristics, Risk, and Navigating in Complex Worlds
13.09.2010
- Mayr, Ulrich**
University of Oregon, USA
Taking Dynamics of Control Seriously: Examples From Serial Order Control and Task Selection
06.05.2009
- McNamara, John**
University of Bristol, UK
The Importance of Individual Differences for Games of Conflict and the Evolution of Cooperation
13.01.2010
- Mensching, Ole**
University of Cologne, Germany
Why do People Trust? A Multi-Perspect Approach
03.03.2010
- Messner, William**
University of Illinois, USA
265 Quantitative Tests of the Priority Heuristic, Cumulative Prospect Theory, and the Transfer-of-Attention-Exchange Model
14.01.2009
- Michaels, Axel**
University of Heidelberg, Germany
Rituals and Emotions: Examples From Nepal
15.12.2009

- Misra, Salil**
Indira Gandhi National Open University, New Delhi, India
Bollywood–Film Colloquium: Mughal–e Azam (1960)
28.04.2009
- Montague, Read**
Baylor College of Medicine, Houston, USA
Economic Probes of Social Cognition
05.05.2009
- Moussaid, Mehdi**
Research Center on Animal Cognition, CNRS
Toulouse, France
Understanding Pedestrian Behavior and Crowd Dynamics Through Simple Heuristics
08.12.2010
- Müller, Sven Oliver**
University of Bielefeld, Germany
Gefühlte Gemeinschaften? Emotionen im Musikleben Europas
29.07.2010
- Nachev, Vadislav**
Humboldt University Berlin, Germany
Psychometric Model of Comparative Reward Evaluation in Nectarivorous Bats
13.07.2010
- Ortner, Tuulia**
Free University Berlin, Germany
Validity of Behaviour Based Tests Assessing Individual Risk Propensity
20.07.2010
- Osman, Magda**
University College London, UK
Controlling Uncertainty: What is the Relationship Between Prediction and Control?
17.03.2010
- Otto, Markus**
University of Bielefeld; University of Braunschweig, Germany
Die systemtheoretische Konzeption von Gefühlen
20.01.2009
- Otto, Ross**
University of Texas at Austin, USA
There Are at Least Two Kinds of Probability Matching: Evidence From a Secondary Task
17.05.2010
- Passerini, Luisa**
University of Turin, Italy
Love and the Idea of Europe
17.11.2009
- Philipp, Otto**
European University Viadrina Frankfurt/O., Germany
Matching Markets With Price Negotiations
16.09.2009
- Plassmann, Hilke**
INSEAD, Fontainebleau, France
The Neural Basis of Simple Economic Decision-Making
27.05.2009
- Reents, Friederike**
Heidelberg, Germany
Stimmung in der Literatur—Eine Standortbestimmung
10.02.2009
- Remaud, Olivier**
EHES and CRPRA Paris, France
The Everyday Cosmopolitanism: A New Role for Emotions?
12.01.2010
- Ridderinkhof, Richard**
University of Amsterdam, Netherlands
Individual Differences in Adaptive Decision-Making
15.12.2009
- Riese, Josef**
University of Paderborn, Germany
Test zur Messung von PCK und CK sowie Beliefs bei Physiklehrern
08.07.2009
- Robitzsch, Alexander**
Bundesinstitut für Bildungsforschung, Innovation und Entwicklung, Salzburg, Austria
Herausforderungen bei Large Scale Assessments
13.10.2009
- Roeder, Brigitte**
University of Hamburg, Germany
The Visual Deprivation Approach to Study (Multi) Sensory Development in Humans
24.03.2009
- Röttger-Rössler, Birgitt**
Free University Berlin, Germany
Männliche Wut und weibliches Mitleid. Emotion, Geschlecht und sozialer Wandel im indonesischen Kontext
03.02.2009
- Sampath, Vikram**
Institute For Advanced Study, Berlin, Germany
The Advent of Recording Technology and its Impact on Indian Classical Music
14.12.2010
- Schneider, Nadja–Christina**
Berlin, Germany
Bollywood–Film Colloquium: Rang de Basanti (2006)
23.06.2009
- Schonlau, Matthias**
RAND, Santa Monica, USA
Health Literacy Skills and the Risk of Coronary Artery Disease
12.01.2010
- Schumann, Dirk**
University of Göttingen, Germany
A Fear Transformed. Violence in Schools and Emotions From the 1950s to the 1970s
03.11.2009
- Sedlmeier, Peter**
University of Chemnitz, Germany
Ugly Male or Attractive Female: How Information About Performers Influences Musical Preferences
21.01.2009
- Seidel, Tina**
University of Jena, Germany
What Does it Really Mean to Use Opportunities to Learn? An Attempt to Tackle a Neglected Field in Education Research
23.01.2009
- Stern, Elsbeth**
Swiss Federal Institute of Technology, Zurich, Switzerland
Future Challenges in Applying Cognitive Science to Education
15.05.2009

- Stuchtey, Benedict**
 German Historical Institute London, UK
 Aspects to the History of Child Adoption
 01.06.2010
- Szrek, Helena**
 University of Porto, Portugal
 Too Smart to Forgo: Cognitive Ability and Subsidized Prescription Drug Insurance
 07.06.2010
- Tanner, Jakob**
 University of Zurich, Switzerland
 Unfassbare Gefühle: Die Rolle der Emotionen in den Geistes- und Sozialwissenschaften vom Fin de Siècle bis in die Zwischenkriegszeit
 13.01.2009
- Tarabout, Gilles**
 LESC (Laboratoire d'Ethnologie et de Sociologie Comparative), Paris, France
 Emotions, Body and Society in South Indian Cultural Practices
 17.02.2009
- Thomä, Dieter**
 University of St. Gallen, Switzerland
 Sympathy Between Homogeneity and Difference
 26.01.2010
- Trivers, Robert L.**
 Rutgers University, New Brunswick, USA
 Deceit and Self-Deception
 23.02.2009
- Vugt, Mark van**
 University of Kent, UK
 The Evolutionary Dynamics of Leadership and Followership Relations
 25.03.2009
- Wahnich, Sophie**
 CNRS, Paris, France
 French Revolution 1789–1794: Emotion Conflicts
 19.05.2009
- Wangenheim, Florian von**
 Technical University of Munich, Germany
 Heuristic-Based Firm Valuation by Financial Analysts: The Role of Brand Perceptions
 04.11.2009
- Waiser Smith, Helmut**
 Vanderbilt University, USA
 A Fatherland to Die for: Literary Friendships, Homosocial Ties and the Language of Sacrifice in the Seven Years War
 16.06.2009
- Wilke, Andreas**
 University of Indiana, USA
 A Functional Approach to the Hot-Hand Fallacy
 15.12.2009
- Wößmann, Ludger**
 Ludwig Maximilians University of Munich, Germany
 Ökonomische Methoden zur Identifikation kausaler Effekte: Einige Beispiele aus der Bildungsökonomik
 28.04.2009
- Zizzo, Daniel**
 University of East Anglia, UK
 Trust, Inequality and the Market
 05.11.2009

3. Conferences, Workshops, and Seminars 2009–2010

Activity and the Brain: Biological Concepts of Plasticity

LIFE workshop

04.03.–06.03.2009

Cultivating Emotion—History, Culture, Society

Joint kick-off workshop of the Center for the History of Emotions and the Centre for the Study of Development of Society, Delhi

09.03.–14.03.2009

Wer will mündige Patienten?

Opening of the Harding Center for Risk Literacy

23.04.2009

Development, Education, Citizenship

Conference in honor of Wolfgang Edelstein's 80th birthday

15.06.2009

Doing Emotions: Past, Present, Future

A multidisciplinary conference

24.06.–26.06.2009

Compassion

A multidisciplinary workshop of the Center for the History of Emotions

03.07.2009

Feeling the Divine: Emotions in Religious Practice. Historical and Cross-Cultural Approaches

International conference of the Center for the History of Emotions

22.07.–25.07.2009

Summer Institute on Bounded Rationality 2009

Summer Institute on Bounded Rationality of the IMPRS on Adapting Behavior in a Fundamentally Uncertain World

26.07.–01.08.2009

Large Knowledge Collider

7th plenary meeting of LarkC

23.09.–25.09.2009

Dynamical Systems Analysis

LIFE workshop (weekly sessions)

September–December 2009

Globalising the History of Concepts?

Round table of the Center for the History of Emotions

20.10.2009

Zeittakte

Workshop of the Center for the History of Emotions

08.01.–09.01.2010

Ein nationaler Bildungsraum: Ein tragfähiges Verfassungsmodell und zugleich ein angemessenes Steuerungskonzept?

German-Swiss expert workshop of the Center for Educational Research

02.03.–03.03.2010

Rechtliche Dimension des Europäischen Qualifikationsrahmens

63. Forum Schulrecht of the Center for Educational Research

18.03.2010

The Life Course: Different Perspectives on Learning

LIFE seminar (weekly sessions)

March–July 2010

History, Emotions, and Visual Media

Conference of the Center for the History of Emotions

21.04.–23.04.2010

Eine Geschichte der Tiere

Conference of the Center for the History of Emotions

22.05.–23.05.2010

Soziale Ungleichheit im Spiegel unterschiedlicher wissenschaftlicher Disziplinen

Scientific symposium on the occasion of the emeritation of Jürgen Baumert

02.07.2010

Foundations of an Interdisciplinary Decision Theory

Summer Institute on Bounded Rationality of the IMPRS on Adapting Behavior in a Fundamentally Uncertain World

05.07.–12.07.2010

Emotional Styles: Communities or Spaces

Conference of the Center for the History of Emotions

22.07.–24.07.2010

Decision Neuroscience—From Neurons to Societies

International workshop of the Max Planck Research Group Neurocognition of Decision Making
23.09.–25.09.2010

LIFE Fall Academy

Fall academy session in Schwanenwerder/Berlin, Germany
14.10.–18.10.2010

Lifespan and Plasticity

LIFE seminar (weekly sessions)
October 2010 – February 2011

Paul B. Baltes Symposium

Symposium in honor of John R. Nesselroade
22.10.2010

Fall Meeting for the Librarians of Max Planck Institutes of the Humanities Section

Conference of the Library
08.11.–09.11.2010

Bildung der Gefühle

Conference of the Center for the History of Emotions
02.12.–04.12.2010

4. Political Delegations and Guests 2009–2010

Visit of a delegation from the Chinese Ministry of Education
30.03.2009

Visit of a delegation from the Chinese Ministry of Education
27.10.2009

Visit of the Korean delegation of the Rural Development Administration
26.11.2009

Visit of the President of the Max Planck Society and 23 secretaries of state from various German ministries
08.12.2009

5. Visiting Researchers 2009–2010

Bäckman, Lars

Karolinska Institute, Stockholm, Sweden
February, April, July, September, November 2009;
January, March, June, October 2010

Baltes, Boris

Wayne University, Detroit, USA
October–November 2009

Banerjee, Madhulika

University of Delhi, India
October 2009 – June 2010

Bard, Amy

Wellesley College, USA
July 2009

Berg, Nathan

University of Texas, Dallas, USA
October 2010

Bielby, Clare

University of Hull, UK
January–July 2009

Blitch, Josh

Colorado State University, USA
July 2010

Boeva, Veselka

Technical University of Sofia, Bulgaria
October–December 2009

Boker, Steve

University of Virginia, Charlottesville, USA
May–June 2009; June, September, October 2010

Brehmer, Yvonne

Karolinska Institute, Stockholm, Sweden
October 2009 – June 2010

Buikstra, Arjon

University of Amsterdam, Netherlands
February 2010

Bunge, Silvia

University of California, Berkeley, USA
February 2009; September–November 2010

Butko, Nicholas

University of California, San Diego, USA
March 2009

Cabeza, Roberto

Duke University, Durham, USA
July 2009

Casey, Anna

Tulane University, New Orleans, USA
September–November 2009

Chandrasekharan, Sruthi

Indian Institute of Technology, Madras, India
May–July 2010

Chater, Nick

University College London, UK
May 2009

Chicherio, Christian

University of Geneva, Switzerland
March 2009

Chow, Sy-Min

University of North Carolina, Chapel Hill, USA
October 2010

Conradt, Larissa

University of Sussex, Brighton, UK
September–December 2010

D'Esposito, Mark

University of California, Berkeley, USA
October 2009

Ditton, Hartmut

Ludwig Maximilians University of Munich, Germany
October 2009

Drechsler, Mareile

London School of Economics and Political Science
(LSE), UK
April–September 2010

Ehrmann–Hämmerle, Christa

University of Vienna, Austria
April 2009 – May 2010

Epstein, Robert

University of California, San Diego, USA
March 2009

Ettlin, Florence

University of Basel, Switzerland
June–July 2010

Fass, Timo

GESIS Leibniz Institute for the Social Sciences,
Mannheim, Germany
June 2009

Feltz, Adam

Florida State University, USA
June 2010

Fernandez, Juan Pablo

Dartmouth College, USA
June 2010

Freund, Alexandra

University of Zurich, Switzerland
January 2009

Garcia–Retamero, Rocio

University of Granada, Spain
April–December 2010

Gates, Kathleen

Pennsylvania State University, University Park, USA
March 2010

Ghisletta, Paolo

University of Geneva, Switzerland
July 2009; July, October 2010

Glöckner, Andreas

MPI for Research on Collective Goods, Bonn,
Germany
May 2009

Gluck, Kevin

Air Force Research Laboratory, USA
August 2010 – July 2011

Goel, Vinod

York University, Toronto, Canada
September 2009 – July 2010

Göritz, Anja

University of Würzburg, Germany
April 2009

Graves, Alex

Technical University of Munich, Germany
May–June 2009

Green, Nile

University of California, Los Angeles, USA
July 2010

Grundmann, Matthias

University of Munster, Germany
February 2010

Gummerum, Michaela

University of Plymouth, UK
March–April, August 2010

- HaCohen, Ruth**
The Hebrew University of Jerusalem, Israel
July 2009
- Hanoach, Yaniv**
University of Plymouth, UK
August 2010
- Hartung, Jan-Peter**
University of London, UK
March 2010
- Heckman, James J.**
University of Chicago, USA
March 2009
- Helversen, Bettina von**
University of Basel, Switzerland
April 2009
- Hertwig, Ralph**
University of Basel, Switzerland
January 2010
- Hertzog, Christopher**
Georgia Institute of Technology, Atlanta, USA
March, May–July 2009; July, September, October 2010
- Hills, Thomas**
University of Basel, Switzerland
April 2009
- Hippel, Bill von**
University of Queensland, Santa Lucia, Australia
March 2009
- Hoffrage, Ulrich**
University of Lausanne, Switzerland
January 2010
- Hohnisch, Martin**
University of Bonn, Germany
March–August 2010
- Jirsa, Viktor**
University of Marseille, France; Florida Atlantic University, Boca Raton, USA
April 2009
- Kanz, Christine**
University of Marburg, Germany
January–July 2010
- Kappesser, Judith**
University of Mainz, Germany
February 2009
- Kennedy, Kristen**
Wayne University, Detroit, USA
August 2009
- King, Andrew**
Institute of Zoology, London, UK
January–April 2009
- Klimesch, Wolfgang**
University of Salzburg, Austria
May 2009
- Kruglanski, Arie**
University of Maryland, College Park, USA
April–May 2009
- Lamm, Claus**
University of Zurich, Switzerland
February 2009
- Leys, Ruth**
Johns Hopkins University, Baltimore, USA
May–June 2010
- Lomasch, Hitashi**
Thapar University, Patiala, India
April–June 2010
- Luan, Shenghua**
School of Social Sciences, Singapore University, Singapore
June 2009
- Madden, David**
Duke University, Durham, USA
December 2010
- Majumdar, Rochona**
University of Chicago, USA
June–July 2009
- Martignon, Laura**
University of Education, Ludwigsburg, Germany
August–October 2010
- Marsh, Herbert, W.**
Oxford University, UK
July 2009
- Mayr, Ulrich**
University of Oregon, Eugene, USA
April–June 2009; July 2010
- McArdle, Jack**
University of Southern California, Los Angeles, USA
July, October 2010
- Messner, William**
University of Illinois, Urbana–Champaign, USA
January 2009
- Misra, Salil**
Indira Gandhi National Open University, New Delhi, India
April–September 2009; October 2010
- Molenaar, Peter C. M.**
Pennsylvania State University, State College, USA
March 2010
- Montague, Read**
Baylor College of Medicine, Houston, USA
May 2009
- Monti, Marco**
University of Milan, Italy
July, September, December 2010
- Mousavi, Shabman**
Georgia State University, Atlanta, USA
June–August 2009; September 2010
- Müller, Stephanie**
University of Mainz, Germany; University of Granada, Spain
April–July 2009; April–August 2010
- Naim, Choudhri Mohammed**
University of Chicago, USA
November 2010
- Naveh–Benjamin, Moshe**
University of Missouri, Columbia, USA
July 2009; July 2010
- Nesselroade, John R.**
University of Virginia, Charlottesville, USA
September–October 2010
- Nielsen, Philipp**
Yale University, USA
January 2009
- Nyberg, Lars**
Umeå University, Sweden
April 2009
- Oberauer, Klaus**
University of Bristol, UK
January 2009
- Okan Gil, Yasmína**
University of Granada, Spain
February–March, June–July 2010

- Oser, Fritz**
University of Fribourg, Switzerland
February, June 2009
- Otte, Stefanie**
Cambridge University, UK
July–August 2010
- Pachur, Thorsten**
University of Basel, Switzerland
April 2010
- Park, Denise**
University of Texas, Dallas, USA
June 2009
- Paz-Alonso, Kepa**
University of Granada, Spain
October 2010
- Pearman, Ann**
Georgia State University, Atlanta, USA
June–July 2009
- Pilz, Karen**
McMaster University, Hamilton, Canada
June 2009
- Pittnauer, Sabine**
University of Bonn, Germany
March–August 2010
- Plassmann, Hilke**
INSEAD Fontainebleau, France
May 2009
- Prescott, Carol**
University of Southern California, Los Angeles, USA
July 2010
- Rahden, Till van**
University of Montreal, Canada
June–August 2009
- Ram, Nilam**
Pennsylvania State University, State College, USA
June–August 2009; October 2010
- Raz, Naftali**
Wayne University, Detroit, USA
June–August 2009; May, July–September, December 2010
- Reb, Jochen**
Singapore Management University, Singapore
July 2010
- Regenwetter, Michel**
University of Illinois, Urbana-Champaign, USA
January–August 2009
- Rieskamp, Jörg**
University of Basel, Switzerland
January, June 2009
- Rodrigue, Karen**
Wayne University, Detroit, USA
August 2009
- Roeder, Brigitte**
University of Hamburg, Germany
March 2009
- Rutter, Nicholas**
Yale University, USA
January–June 2009
- Sachdeva, Shweta**
University of Delhi, India
June 2010
- Schmitz, Bernhard**
University of Darmstadt, Germany
October 2010
- Sedlmeier, Peter**
University of Chemnitz, Germany
January 2009
- Segalowitz, Sid**
Brock University, St. Catharines, Canada
October 2009
- Sharifi, Marian**
London School of Economics and Political Science (LSE), UK
October–December 2009; January–March, June–August 2010
- Sharma, Sunil**
Boston University, USA
May 2010
- Shavelson, Richard J.**
Stanford University, Palo Alto, USA
February 2009
- Singer, Tania**
University of Zurich, Switzerland
February 2009
- Sliwinski, Martin**
Pennsylvania State University, State College, USA
August 2010
- Sundström, Anna**
Umeå University, Sweden
January–July 2010
- Temprado, Jean-Jacques**
Université De La Méditerranée, Marseille, France
June 2009
- Todd, Peter**
Indiana University, Bloomington, USA
July 2010
- Treese, Anne-Cecile**
Lund University, Sweden
March 2009
- Trivers, Robert**
Rutgers University, New Brunswick, USA
February 2009
- Vaizey, Hester**
University of Cambridge, UK
January–February 2009
- Vugt, Mark van**
University of Kent, Canterbury, UK
March 2009
- Watanabe O'Kelly, Helen**
Exeter College, University of Oxford, UK
January–March 2009
- Wierling, Dorothee**
University of Hamburg, Germany
October 2009 – March 2010
- Woollacott, Marjorie**
University of Oregon, Eugene, USA
April–May, September 2009

6. Other Professional Activities 2009–2010

Jürgen Baumert

- Max Planck Society (Vice-President, Human Sciences Section, 2006–2008)
- Jacobs Foundation, Zurich, Switzerland (Member of Board of Trustees)
- Institute for Educational Progress, Humboldt University Berlin (Member of Board of Trustees)
- Research Program "Professional Minds of Teachers: On the Development of Standards for Vocational Teachers," University of Fribourg, Switzerland (Member of Advisory Board)
- Quality Agency of the State Institute of School Education and Educational Research (ISB), Munich (Member of Board of Scientific Advisers)
- University of Twente, Institute for Behavioral Research (IBR) (Member of Board of Trustees)
- Action Program "New Paths in Teacher Training," Founders' Association of German Science, Bonn (Member of Board of Scientific Advisers)
- Leibniz Association (Member of Senate and Evaluation Committee)
- Internationale Grundschul-Lese-Untersuchung (IGLU)/Progress in International Reading Literacy Study (PIRLS) (Member of Advisory Board)
- Center for Research on Learning and Instruction, University of Erfurt (Member of Advisory Board)
- Psychologie in Erziehung und Unterricht (Member of Advisory Board)
- Schweizerische Zeitschrift für Bildungswissenschaften (Member of Advisory Board)
- Zeitschrift für Erziehungswissenschaft (Coeditor)
- Zeitschrift für Pädagogische Psychologie (Member of Advisory Board)
- Center for School Research and Questions of Teacher Education, Martin Luther University Halle-Wittenberg (Member of Advisory Board)
- Waxmann Verlag, Reihe Pädagogische Psychologie und Entwicklungspsychologie (Member of Advisory Board)
- Zeitschrift für Unterrichtswissenschaft (Coeditor)
- Jacobs Center on Lifelong Learning and Institutional Development (JCLL), Jacobs University Bremen (Member of Advisory Board)
- European Science Foundation, Strasbourg (Member of Pedagogical and Educational Research Expert Panel)
- University of Kassel (Member of University Council)
- "Bürger Netzwerk Bildung" (Member of Advisory Board)
- State Institute for School Quality in Berlin und Brandenburg (ISQ) (Member of Advisory Board)
- Expert Committee to Assess Teacher Training in North Rhine-Westphalia (Chair)
- International Academy of Education (Fellow)
- Carnegie Foundation for the Advancement of Teaching (Member of Board of Trustees)
- "Haus der kleinen Forscher" (McKinsey) (Member of Advisory Board)
- "School Reform and Beyond" (David L. Featherman) (Member of Advisory Board)
- Dahlem Conferences (Member of Advisory Board)
- Expertenrat "Herkunft und Bildungserfolg" des baden-württembergischen Staatsministeriums (Chair)

Henry J. Brighton

- Berlin School of Mind and Brain (Faculty Associate)

Wolfgang Edelstein

- Institut für angewandte Familien-, Kindheits- und Jugendforschung e.V., Potsdam (Member of Board of Scientific Advisers)
- Irmgard-Coninx-Stiftung (Member of Advisory Council)
- Yehudi Menuhin Stiftung Deutschland (Member of Board of Trustees)
- Deutsche Gesellschaft für Demokratiepädagogik (German Association for Democratic Education) (Member of Board of Directors)
- Akademie für Bildungsreform (Member)
- Buddy e.V. (Member of Board of Advisers)
- New Directions for Youth Development, New York (Member of Editorial Board)
- Entwicklungswissenschaft. Biopsychosoziale Forschung und Anwendung (Member of Board of Advisers)
- Free University Berlin (Honorary Professor of Educational Sciences)

- Flavia Filimon**
- Society for Neuroscience (Member)
 - Cognitive Neuroscience Society (Member)
 - Neuroimage (Reviewer)
 - Journal of Neurophysiology (Reviewer)
 - Experimental Brain Research (Reviewer)
 - Philosophical Psychology (Reviewer)
- Ursula Flitner**
- German Special Library Association (ASpB), Section 5 of the German Library Association (DBV) (Deputy Chair) (until 2009)
 - Member of the Board of "Bibliothek & Information Deutschland" (BID), the Umbrella Organization of the Library Institutional and Personnel Associations, the Information Science Societies, F3 Central Bodies for the Promotion of Cultural Affairs in Germany (until 2009)
- Ute Frevert**
- German Academy of Sciences Leopoldina, Section "Cultural Sciences" (Member)
 - Arbeitskreis für moderne Sozialgeschichte (Member)
 - Dahlem Conferences (Advisory Board)
 - Einstein Forum (Advisory Board)
 - European Studies Review (Editorial Board)
 - Free University Berlin (Honorary Professor of History)
 - Geschichte und Gesellschaft (Managing Director and Member of the Editorial Board)
 - Institute for Human Sciences, Vienna (Board of Trustees)
 - Jacobs University Bremen (Supervisory Board)
 - Journal of Contemporary History (Editorial Board)
 - Journal of Modern History (Editorial Board)
 - Kurt-A.-Körber-Stiftung—Geschichtswettbewerb des Bundespräsidenten (Board of Trustees)
 - Centre for Interdisciplinary Research, University of Bielefeld (Board of Trustees) (until 2009)
 - Zentrum für Zeithistorische Forschung, Potsdam (Board of Trustees)
 - Zukunftskolleg University of Konstanz (Advisory Board)
 - Humboldt-Viadrina School of Governance (Board of Trustees)
 - Alexander-von-Humboldt-Stiftung (International Advisory Board)
 - Berlin-Brandenburg Academy of Sciences and Humanities (Member)
 - American Academy (Selection Committee)
 - International Institute for Social History, Amsterdam (Advisory Board) (until 2009)
- Wolfgang Gaissmaier**
- Frontiers in Quantitative Psychology and Measurement (Review Editor)
- Mirta Galesic**
- Medical Decision Making (Editorial Board)
- Gerd Gigerenzer**
- Berlin-Brandenburg Academy of Sciences and Humanities (Member)
 - German Academy of Sciences Leopoldina (Fellow)
 - Theory and Psychology (Advisory Editor)
 - Journal of Behavioral Decision Making (Editorial Board)
 - Evolution and Human Behavior (Editorial Board)
 - Summer Institute on Bounded Rationality in Psychology and Economics (Codirector)
 - Organizational Behavior and Human Decision Process (Editorial Board)
 - Bundesinstitut für Risikobewertung, Germany (Advisory Board)
 - European Society for Philosophy and Psychology (ESPP) (Advisory Board)
 - Psychological Inquiry (Editorial Board)
 - Frankfurt Institute for Advanced Studies Forum (Advisory Board)
 - Risk and Security, Technical University of Munich (Advisory Board)
 - International Herbert A. Simon Society (Founding Member)
 - 16th Cochrane Colloquium of 2008 (Scientific Program Committee)
 - Board of the APS Policies (Advisory Committee of International Scholars)
- Axinja Hachfeld**
- Max Planck PhDNet (Section Representative of the Humanities)
- Dorothea Hämmerer**
- Max Planck PhDNet (Survey Working Group)

- Hauke R. Heekeren**
- Acta Neuropsychiatrica (Editorial Board)
 - Frontiers in Human Neuroscience (Associate Editor)
 - Frontiers in Decision Neuroscience (Chief Editor)
 - Organization for Human Brain Mapping HBM (Member)
 - Cognitive Neuroscience Society (Member)
 - Society for Neuroscience (Member)
- Monika Keller**
- Erwägen, Wissen, Ethik (Editorial Board)
 - European Developmental Science (Editorial Board)
 - Jean Piaget Society (Ex-Officio Member of Board of Directors)
 - American Field Service (Board Member)
- Shu-Chen Li**
- Neuroscience and Biobehavioral Reviews (Board of Consulting Editors)
 - Psychology and Aging (Board of Consulting Editors)
 - Max Planck Society (Institute Scientific Staff Representative in the Human Sciences Section)
 - Developmental Psychology (Associate Editor)
 - Frontiers of Decision Neuroscience (Associate Editor)
 - Neuroscience and Biobehavioral Reviews (Guest Editor)
- Ulman Lindenberger**
- European Journal of Developmental Science (Member of Editorial Board)
 - Centre for Population Studies (CPS), Umeå University, Sweden (Member of the Board of Ageing and Living Conditions Programme, ALC)
 - Margret M. and Paul B. Baltes Foundation for the Advancement of Research in Developmental Psychology and Gerontology (Member of the Board)
 - Nordic Centre in Cognitive Control (Member of the Scientific Advisory Board)
 - Gerontological Society of America (Fellow)
 - Wilhelm-Wundt-Gesellschaft (Member)
 - Alexander-von-Humboldt-Stiftung (Member and Selection Committee for Humboldt Research Awards)
 - German Academy of Sciences Leopoldina (Member of Section 26 "Psychology and Cognitive Sciences")
 - Akademiengruppe Altern: Opportunities and Problems of an Aging Society: The World of Work and Lifelong Learning, launched together by the German Academy of Sciences Leopoldina and acatech-Council for Engineering Sciences at the Union of the German Academies of Science and Humanities (Member of Working Group on Aging)
 - Psychology and Aging (Member of Editorial Board)
 - Aging, Neuropsychology, and Cognition (Member of Editorial Board)
 - International Journal of Behavioral Development (Member of Editorial Board)
 - Gerontology: Regenerative and Technological Science Section (Member of Editorial Board)
 - GeroPsych – The Journal of Gerontopsychology and Geriatric Psychiatry (Member of Editorial Board)
 - German Research Foundation (DFG), Review Board (Fachkollegium) 110 "Psychology," Sub-Division 110-02 "Developmental Psychology and Educational Psychology" (Member of Review Board)
 - International Society for the Study of Behavioural Development (ISSBD) (Member of Executive Committee)
 - Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie (Member of Advisory Board)
 - German Institute for International Educational Research (DIPF), Frankfurt a. M. (Member of Scientific Advisory Board)
 - Interdisciplinary Wolfgang Köhler Research Centre on Conflicts in Intelligent Systems, Humboldt University Berlin (Member of Scientific Board)
 - Rotman Research Institute, Toronto, Canada (Member of External Review Team)
 - Ontario Brain Initiative, Toronto, Canada (Member of the International Scientific Advisory Board)
 - American Psychological Association (Fellow)
 - Association for Psychological Science (Fellow)
 - LIVES National Centre of Competence in Research, funded by the Swiss National Science Foundation (Member of the International Scientific Committee)

- Julian N. Marewski**
- Journal of Organizational Moral Psychology (Editorial Board)
 - Judgment and Decision Making (Guest Editor of special issues)
- Hansjörg Neth**
- International Conference on Cognitive Modeling (ICCM) (Program Committee Member)
- Margrit Pernau**
- Concepta (International Research School in Conceptual History and Political Thought) (Advisory Board)
 - Geschichte und Gesellschaft, Journal of History Social Sciences (Editorial Board)
 - Contributions to the History of Concepts (Editor)
- Michaela Riediger**
- Emotion (Member of Consulting Editor Board)
 - German Institute for Economic Research (Research Affiliate)
 - International Max Planck Research School "The Life Course: Evolutionary and Ontogenetic Dynamics (LIFE)" (Faculty Member)
 - Ethics Committee of the Max Planck Institute for Human Development (Head)
- Lael J. Schooler**
- Frontiers in Cognitive Science (Associate Editor)
 - U.S. National Science Foundation, Program on Decision, Risk, and Management Science (Member of the Advisory Panel)
 - Psychological Review (Consulting Editor)
- Jeffrey R. Stevens**
- Frontiers in Comparative Psychology (Editor-in-chief)
 - Frontiers in Psychology (Associate Editor)
 - Strüngmann Forum on Evolving the Mechanisms of Decision Making (Co-chairperson)
 - Center for Integrative Life Sciences (Associate Researcher)
- Kirsten G. Volz**
- Zentrum für interdisziplinäre Forschung, University of Bielefeld (Member)
- Claudia Wassmann**
- Interdisciplinary Program on Suffering and Pain, University of Luxembourg (Member)
 - Swiss Center for Affective Sciences (Associate Member)

7. Academic Degrees 2009–2010

Habilitations

McElvany, Nele (2009). Kernaspekte erfolgreichen Kompetenzerwerbs: Entwicklung der Lesekompetenz und Übergang auf die weiterführende Schule. Free University Berlin.

Riediger, Michaela (2010). Adult development at the intersection of motivation, behavior, and subjective experience. University of Zurich.

Doctoral Dissertations

Bartling, Karen (2010). Social interaction in infancy: Contingency perception and the role of maternal affect attunement. Humboldt University Berlin.

Brose, Annette (2009). Daily stress, affect, self-regulation, and cognitive performance: Person-context and cross-domain couplings in younger and older adults. Humboldt University Berlin.

Burzynska, Agnieszka Zofia (2010). Adult age differences in brain structure and their cognitive, and functional implications. Humboldt University Berlin.

Dettmers (Pieper), Swantje (2010). Effektive Hausaufgaben: Untersuchungen zu einem psychologischen Rahmenmodell. Free University Berlin.

Hämmerer, Dorothea (2009). Lifespan differences in performance monitoring functions. Humboldt University Berlin.

Heukelom, Floris (2009). Kahneman and Tversky and the making of behavioral economics. University of Amsterdam.

Jonkmann, Kathrin (2009). Soziale Dynamik im Klassenzimmer: Person- und Kontextperspektiven auf Dominanz und Affiliation in der Adoleszenz. Free University Berlin.

Kunina-Habenicht, Olga (2010). Theoretical and practical considerations for implementing diagnostic classification models: Insights from simulation-based and applied research. Humboldt University Berlin.

Marewski, Julian N. (2009). Ecologically rational strategy selection. Free University Berlin.

Morais, Ana Sofia (2010). The content and structure of natural semantic representations. Humboldt University Berlin.

Master's and Diploma Theses

Bach, Anabel (2010). Delinquenz und prosoziales Verhalten—eine Studie zum Verhalten delinquenten Jugendlicher im Diktatorspiel. Free University Berlin.

Biesenack, Julia (2010). Single nucleotide polymorphisms und ihre Auswirkung auf Aufmerksamkeit und Kognition. Humboldt University Berlin.

Schroeder, Sascha (2010). Modellierung und Erfassung kognitiver Prozesse beim Textverstehen von Schülerinnen und Schülern. Free University Berlin.

Nagel, Irene E. (2009). Understanding the heterogeneity of working memory aging: Contributions from behavioral neuroscience and genetics. Humboldt University Berlin.

Neumann, Marko (2009). Aktuelle Problemfelder der gymnasialen Oberstufe und des Abiturs: Öffnung von Wegen zur Hochschulreife, Umbau des Kursystems und die Vergleichbarkeit von Abiturleistungen. Free University Berlin.

Rauers, Antje (2009). Interactive expertise and dyadic common ground in younger and older couples. Free University Berlin.

Richter, Dirk (2010). Lebenslanges Lernen von Lehrkräften: Die Bedeutung von Mentoren im Vorbereitungsdienst und die Nutzung beruflicher Lerngelegenheiten. Free University Berlin.

Studtmann, Markus (2009). Wissen wir, was wir zeigen, wenn wir etwas fühlen? Systematische Fehleinschätzungen des eigenen mimischen Emotionsausdrucks. University of Greifswald.

Verrel, Julius (2010). Movement variability and coordination in early and late adulthood. Humboldt University Berlin.

Voss, Tamar (2010). Generelles pädagogisch-psychologisches Wissen und lerntheoretische Überzeugungen von Lehrkräften als Aspekte der Lehrkompetenz. Free University Berlin.

Werkle-Bergner, Markus (2009). Age differences in episodic memory and visual perception across the lifespan: Insights into dynamic structure-function relations from behavioral and electrophysiological investigations. Humboldt University Berlin.

Busching, Robert (2009). Fluktuation im Wohlbefinden bei Lehramtsanwärtern: Einfluss von Stressoren und Ressourcen. Dresden Technical University.

Dietrich, Claudia (2010). The neural correlates of crossmodal synchrony and asynchrony perception in 6-month-old infants: Insights from an EEG/ECG study. Technical University of Berlin.

- Frisch, Susan** (2010). Spontanes motorisches Tempo in der frühen Mutter-Kind-Interaktion. Technical University of Berlin.
- Gluth, Sebastian** (2009). Cortical thickness and executive functioning in healthy younger and older adults. Humboldt University Berlin.
- Hartmann, Rebecca Miriam** (2009). Entwicklung von Lesekompetenz in Abhängigkeit von der Kongruenz zwischen Schulsprache und Familiensprache. Free University Berlin.
- Jagenow, Danilo** (2010). Effects of cognitive load and walking speed on walking regularity and cognitive performance in children and young adults: A dual-task approach. University of Potsdam.
- Kämmer, Juliane** (2009). Recognition in economic group decisions—Is it special? Humboldt University Berlin.
- Karduck, Eva** (2010). Age differences in visual working memory: The role of alpha-oscillations for the inhibition of irrelevant information. Humboldt University Berlin.
- Klipker, Kathrin** (2009). Aktivierung statt Valenz? Affekt und Arbeitsgedächtnisleistung von der Jugend bis ins hohe Alter. University of Bochum.
- Kwiatkowska-Naqvi, Shireen** (2010). Brain volume changes due to cognitive practice. Humboldt University Berlin.
- Krüger, Daniela** (2010). Bildungsgerechtigkeit im Hochschulzugang. Studierneigung vor dem Hintergrund von Bildungschancen und dem Prinzip der Meritokratie. Humboldt University Berlin.
- Maleika, Djamila** (2010). Effects of dual-tasking on cognitive control and walking regularity in children. Technical University of Berlin.
- Rosenauer, Martin** (2009). Informiertheit bei Entscheidungen unter Unsicherheit im Investmentbereich. Free University Berlin.
- Schirmann, Felix** (2009). The perception of auditory-visual temporal synchrony in six-month-old infants. Free University Berlin.
- Schmückling, Nelly** (2010). Spital discounting of food and social partners in guppies (*poecilia reticulata*). Humboldt University Berlin.
- Schneider, Carolin** (2010). "Geliebt, gelobt, geschätzt—zufrieden? Der Einfluss sozialer Ressourcen auf das subjektive Wohlbefinden." University of Potsdam.
- Seiz, Johannes** (2009). Lehrer-Selbstwirksamkeitserwartung unter Berücksichtigung des Professionswissens: Auswirkungen auf das berufliche Wohlbefinden und die Lernbereitschaft von Lehramtskandidatinnen und Lehramtskandidaten. Free University Berlin.
- Silberhorn, Birgit** (2010). Does experts' disclosure of uncertainty necessarily decrease their credibility? Humboldt University Berlin.
- Nöller, Jana** (2010). Schulformwahl zwischen Elternwille und Übergangsempfehlung—Der Übergang von der Grundschule in die weiterführende Schule. Technical University of Berlin.
- Papenberg, Goran** (2009). Higher intraindividual variability is associated with higher forgetting rates and dedifferentiated memory systems in older adults. Humboldt University Berlin.
- Wenger, Elisabeth** (2010). Brain plasticity: Gray matter alterations in younger and older adults caused by 100 days of cognitive training. Free University Berlin.
- Zimmer, Johanna** (2009). Studium nach Plan? Psychosoziale Anpassung und studienrelevantes Erleben und Verhalten beim Übergang in die tertiäre Ausbildung. University of Leipzig.

8. Research and Professional Staff 2009–2010



Assmann, Wolfgang (Head of Information Processing Center): Service management in research institutions; information technology in the social and behavioral sciences.



Baumert, Jürgen (State Examination for Teachers, 1968, Hamburg; Dr. phil., 1968, University of Tübingen; Habilitation in Educational Sciences, 1982, Free University Berlin; Fellow of the Max

Planck Society; Co-director of the Institute; Professor of Educational Sciences, Free University Berlin and Humboldt University Berlin; Vice President of the Max Planck Society, 2006–2008; Director emeritus, July 2010): Research in teaching and learning; cultural comparisons, large-scale assessment, cognitive and motivational development in adolescence. (CER)



Baumgarten, Jürgen (Dr. phil. in German Language and Literature, 1973, Free University Berlin; Former Head of Editorial and Public Relations Department): Prehistory of the Middle East; neolithization; no-

madic cultures.



Becker, Michael (M.A. in History, 2004, Free University Berlin; Diploma in Psychology, 2004, Free University Berlin; Dr. phil. in Psychology, 2008, Free University Berlin): Cognitive develop-

ment; changes in educational systems; quantitative methods in social sciences. (CER)



Bodammer, Nils (Dr. ner. nat. in Physics, 2005, University of Magdeburg): Quantitative magnetic resonance imaging of the human brain; functional magnetic resonance imaging; devel-

opment of algorithms for MRI data processing. (LIP)



Brauer, Juliane (M.A. in History and Musicology, 2001, Humboldt University Berlin; Dr. phil. in Politics, 2007, Free University Berlin): Music making as an emotional practice; German social- and culture history; history of education; culture and practices of remembrance; popular history culture. (HoE)



Brighton, Henry J. (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): Cogni-

tion-inspired approaches to artificial intelligence and machine learning; human decision making under risk and uncertainty; computational evolutionary linguistics. (ABC)



Czienskowski, Uwe (Diploma in Psychology, 1990, Free University Berlin; Dr. phil. in Psychology, 1995, Free University Berlin; Diploma in Computer Science, 2007, University of Applied Sciences, Trier): Development of scientific software applications for the lab and the web; software engineering; distributed computing; quantitative research methods; modeling and simulation. (ABC)



Dettmers (Pieper), Swantje (Diploma in Psychology, 2006, University of Munster; Dr. phil. in Educational Sciences, 2010, Free University Berlin): National and international school

achievement research; quality assurance and quality improvement in the educational system; effects of homework assignment on academic achievement. (CER)



Delius, Julia A. M. (Dr. med., 1993, University of Frankfurt a. M.): Scientific coordination; editorial projects; interdisciplinary gerontology in the context of the Berlin Aging Study (BASE); BASE website design and management. (LIP)



Eifert, Christiane (M.A. in History, Political Sciences, Romance Studies, 1983, Technical University of Berlin; Dr. phil. in History, 1991, Technical University of Berlin; Habilitation, 2000, Free University Berlin; 2003–2008 Interim Professor University of Bielefeld): History of gender; history of work; history of welfare states. (HoE)



Eitler, Pascal (M.A. in History, 2001, University of Bielefeld and E.H.E.S.S. Paris; Dr. phil. in Modern History, 2008, University of Bielefeld): Human-animal relationships in modern history; body history of the 19th and 20th century; history of religion in West Germany. (HoE)



El-Khechen (Abou-Saleh) Wahiba (Diploma in Psychology, 2009, University of Bochum): Capability of the first language in promoting language skills in a second language; conception and evaluation of systematic interventions in the school context; educational disadvantaged students with and without immigrant background; multiple aims of schools. (CER)



Elsner, Jürgen (Diploma in Mathematics, 1966, University of Göttingen; Dr. rer. nat. in Mathematics, 1969, University of Göttingen; Habilitation in Mathematics, 1977, University of Kiel): Cultural comparisons in mathematics with students and teachers. (CER)



Engelhardt, Nicole (M.A. in Cultural Anthropology, 2001, University of Cologne; Wissenschaftliche Dokumentarin/Information Specialist, Subject Librarian, 2003, University of Applied Sciences, Potsdam): Scientific electronic information systems, classification, bibliometrics.



Fific, Mario (Joint PhD in Cognitive Psychology and Cognitive Science, with Certificate in Mathematical Modeling, Indiana University): Development of a general information processing model of human cognition; process tracing techniques; selection of decision strategies; visual and memory search and perceptual categorization. (ABC)



Flitner, Ursula (M.A. in American Studies and German Literature, 1991, Free University Berlin; State Examination in Library and Information Science, 1995, Senatsverwaltung für Kulturelle Angelegenheiten Berlin/Cologne; Head of the Library and Research Information Unit): Information management; electronic resources and networked information systems; human resources development.



Fox-Kuchenbecker, Petra (Dr. rer. nat. in Biology, 1995, Humboldt University Berlin; Public Relations Specialist, 2003, PR Kolleg Berlin; Head of Public Relations Department): Integrated communications; scientific communication with the media and the lay public.



Frevert, Ute (Dr. phil. in History, 1982, University of Bielefeld; Habilitation in Modern History, 1989, University of Bielefeld; Scientific Member of the Max Planck Society; Co-director

of the Institute; Honorary Professor of History, Free University Berlin): Social and cultural history of modern times; gender history; political history; history of emotions. (HoE)



Gaissmaier, Wolfgang (Diploma in Psychology, 2002, Free University Berlin; Dr. phil. in Psychology, 2007, Free University Berlin): 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. (Harding Center/ABC)



Galesic, Mirta (PhD in Psychology, 2004, University of Zagreb; M.Sc. in Survey Methodology, 2005, Joint Program in Survey Methodology, University of Maryland/University of Michigan): Judgment

and decision making; sampling approaches to cognition; risk communication; survey methodology. (ABC)



Gammerl, Benno (M.A. in Cultural History, 2000, University of London; M.A. in History, 2003, Free University Berlin; Dr. phil. in Modern History, 2008, Free University Berlin): Imperial history; citizenship and decision making; contemporary history of homosexuality in Germany; oral history. (HoE)



Gigerenzer, Gerd (Dr. phil. in Psychology, 1977, University of Munich; Habilitation in Psychology, 1982, University of Munich; Fellow of the Max Planck Society; Co-director of the Institute; Director of the Harding Center for Risk Literacy; Honorary Professor of Psychology at the Free University and the Humboldt University Berlin; Batten Fellow at the Darden Business School, University of Virginia): Models of bounded rationality; social intelligence; ecological rationality; public understanding of risk; heuristics of scientific discovery; philosophy, history, and methodology of the so-

cial sciences; risk communication; decision-making strategies of judges and physicians. (ABC)



Heekeren, Hauke R. (Dr. med., 2000, Humboldt University Berlin; License for the practice of medicine, 2000): Neurobiology of perceptual decision making; motivation and affect in decision making; cognitive and affective components in normal and disturbed social cognition; multimodal neuroimaging. (MPRG Neurocognition)



Hitzer, Bettina (First State Examination in History and French, 1999, Free University Berlin; Dr. phil. in History, 2004, University of Bielefeld): History of emotions; history of migration; history of religion; history of medicine. (HoE)



Jensen, Uffa (M.A. in History and Philosophy, 1998, Technical University of Berlin; Dr. phil. in Modern History, 2003, Technical University Berlin): History of knowledge and human sciences; transnational history; history of psychoanalysis; modern Jewish history; history of anti-Semitism. (HoE)



Jonkmann, Kathrin (Diploma in Psychology, 2005, Humboldt University Berlin; Dr. phil. in Psychology, 2009, Free University Berlin): Social relationships in the classroom; educational transitions; school achievement research. (CER)



Julius-McElvany, Nele (Diploma in Psychology, 2001, Free University Berlin; Dr. phil. in Psychology, 2006, Free University Berlin; Habilitation in Psychology, 2009, Free University Berlin): Research in instruction and learning; reading

literacy; teacher research; influences of family background on achievement; self-regulated learning. (CER)



Katsikopoulos, Konstantinos V. (PhD in Industrial Engineering and Operations Research, 1999, University of Massachusetts, Amherst): Theory: models of decision making (prescriptive and

descriptive); applications: decisions "in the wild" (business, engineering, medicine, ecology). (ABC)



Keller, Monika (Dr.phil. in Psychology, 1974, University of Heidelberg; Habilitation in Psychology, 1996, Free University Berlin; Honorary professor of Psychology, Free University Berlin): Social

perspective taking, theory of mind, and domains of social and moral reasoning; moral cognition and emotions in cultural context; development and education of social and moral competence; interconnecting moral psychology with behavioral game theory. (ABC)



Kleickmann, Thilo (First State Examination for Primary School Teachers, 1999, University of Munster; Second State Examination for Primary School Teachers, 2002, Teacher Training College at Bochum; Dr.paed., 2008, University of Munster): Teaching and learning (especially in primary science); teachers' professional development; teacher knowledge and beliefs. (CER)



Klusmann, Uta (Diploma in Psychology, 2004, Free University Berlin; Dr.phil. in Psychology, 2008, Free University Berlin): Research in teachers' occupational well-being and health; teachers'

development of teachers professional competence; emotion and coping skills in educational environments. (CER)



Kopp, Franziska (Diploma in Psychology, 1999, University of Leipzig; Dr.rer.nat. in Psychology, 2006, University of Leipzig): Social and cognitive development in the first year of life; EEG in infancy; timing mechanisms of social interaction processes in infants and adults; audiovisual integration; memory processes; joint attention; action simulation. (LIP)



Kruse, Imke (Dr.phil. in Political Science, 2005, Free University Berlin; Research Manager, Center for Lifespan Psychology; LIFE Program Manager): Aging policy for elderly migrants in Europe; asylum

and migration policies. (LIP)



Kunina-Habenicht, Olga (Diploma in Psychology, 2006, Humboldt University Berlin; Dr.rer.nat. in Psychology, 2010, Humboldt University Berlin): Teacher research; psychometric modeling (cognitive

diagnosis models, SEM, IRT). (CER)



Kunter, Mareike (Diploma in Psychology, 1999, Julius Maximilians University of Würzburg; Dr.phil. in Psychology, 2004, Free University Berlin; Habilitation in Psychology, 2008, Free University Berlin): Research in instruction and learning; teacher research; multiple educational objectives; motivational processes in the classroom; assessment of instructional processes. (CER)



Kurz-Milcke, Elke (Diploma in Psychology, 1991, University of Konstanz; PhD in Psychology, 1997, Bowling Green State University, Ohio): Cognition and mathematics. (ABC)



Li, Shu-Chen (PhD in Psychology, 1994, University of Oklahoma; Habilitation in Psychology, 2006, Free University Berlin; Honorary Professor of Psychology, 2008, Free University Berlin): Behavioral

and neurocognitive development across the lifespan; neuromodulation and perception of cognition; neuroeconomics and aging; bio-cultural co-construction of development; collaboration in the Berlin School of Mind and Brain, Bernstein Focus "Neuronal Basis of Learning" Project. (LIP)



Lindenberger, Ulman (Dr.phil. in Psychology, 1990, Free University Berlin; Habilitation in Psychology, 1998, Free University Berlin; Fellow of the Max Planck Society; Co-director of the

Institute; Professor of Psychology, Saarland University; Professor of Psychology, Free University Berlin; Professor of Psychology, Humboldt University Berlin): Lifespan psychology: theories and methods; behavioral plasticity and its neural correlates in childhood and old age; sensorimotor and cognitive development; multivariate measurement of change and variability. (LIP)



Maaz, Kai (Diploma in Education [FH], 1998, Catholic University of Applied Sciences Berlin; Diploma in Social Sciences, 2002, Humboldt University Berlin; Dr.phil. in Educational Science, 2006, Free University Berlin; Habilitation in Educational Science, 2008, Free University Berlin): Transition from school to university and work; social background and educational and vocational chances; social inequality and educational decisions. (CER)



Michl, Susanne (M.A. in Modern History, University of Tübingen, 2002; Maîtrise, Histoire, Université de Provence, Aix-en-Provence, 2002; Dr.phil. in Modern History, University of

Tübingen, 2006): Medical history and ethics; war and medicine; colonial history; professional history of German and French physicians; history of the doctor-patient-relationship. (HoE)



Milek, Anne (Diploma in Psychology, 2009, Free University Berlin): Educational psychology; reference group effects on cognitive (e.g., self-concept) and health related outcomes (e.g., SWB, coping strategies); transition processes; quantitative research methods (large scale data assessment, questionnaire development); sports psychology. (CER)



Müller, Sven Oliver (M.A. in Modern and Ancient History, 1994, University of Bielefeld; Dr.phil. in History, 2001, University of Bielefeld): Nationalism in Germany and Britain; opera in a developing

society; markets for musical theatre in modern Europe. (MPRG Felt Communities)



Mueller, Viktor (Dr. rer. soc., 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)



Nagy, Gabriel (Diploma in Psychology, 2002, Free University Berlin; Dr.phil. in Psychology, 2006, Free University Berlin; Juniorprofessor at the University of Tübingen, 2010): Transition from

school to university and work; determinants of success in tertiary education; cognitive and motivational development; measurement and assessment; quantitative research methods; research in teaching and learning; developmental regulation across the lifespan. (CER)



Nagy (Husemann), Nicole (Diploma in Psychology, 2004, University of Bielefeld; Dr.phil. in Psychology, 2007, Free University Berlin): Research in teaching and education; personal goals;

academic cheating. (CER)



Nelson, Jonathan D. (M.S. in Cognitive Science, 2002, University of California, San Diego; PhD in Cognitive Science, University of California, San Diego, 2005): Fast and frugal trees,

learning and information search in uncertain real-world environments; neural bases of the value of information for categorization; use of optimal experimental design principles to design informative behavioral experiments; communication of probabilities using experience-based learning and natural sampling; Bayesian modeling of learning on probabilistic and deterministic categorization tasks. (ABC)



Neumann, Marko (M.A. in Educational Sciences, 2006, Humboldt University Berlin; Dr.phil. in Educational Sciences, 2009, Free University Berlin): National and international school

achievement research; impact of institutional opportunity structures on the development of scholastic abilities; school effectiveness research; quality assurance and quality improvement in the educational system. (CER)



Neth, Hansjörg (PhD in Psychology, 2004, Cardiff University, UK): Stopping rules; sequential decision making; embodied and embedded cognition; ecological rationality. (ABC)



Oertzen, Timo von (Diploma in Computer Science, 1999, Saarland University; PhD in Computer Science, 2003, Saarland University): Mathematical psychology; algorithms in psychology; statistical modeling; formal modeling. (LIP)



Olsson, Henrik (PhD in Psychology, 2000, Uppsala University): Computational modeling; judgment and decision making; categorization, estimation, and causal learning; adaptiveness of cognitive mechanisms to environmental structures; working memory capacity. (ABC)



Pernau, Margrit (Dr.phil. in Modern History, 1991, University of Heidelberg; Habilitation, 2007, University of Bielefeld): Indian history, 18th–20th centuries; history of modern Islam; transnational history, history of entanglement; historical semantics, comparative studies, and translation studies. (HoE)



Plamper, Jan (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. (HoE)



Quesada, José (PhD in Psychology, 2003, University of Granada, Spain): Computational modeling; semantic web; problem solving; judgment and decision making; mental number line; ecological rationality; social networks. (ABC)



Rauers, Antje (Diploma in Psychology, 2005, Free University Berlin; Dr. phil. in Psychology, 2008, Free University Berlin): Affective competencies across adulthood; affective dynamics between

social interaction partners collaborative cognition. (MPRG Affect)



Riediger, Michaela (Diploma in Psychology, 1997, Humboldt University Berlin; Dr. phil. in Psychology, 2001, Free University Berlin; Habilitation in Psychology, 2010, University of Zurich): Lifespan

changes in the interplay of affect, motivation, and cognition; affect dynamics and affective competencies (affect regulation and affect communication); social aspects of motivational and affective processes. (MPRG Affect)



Rjosk, Camilla (Diploma in Psychology, 2008, Free University Berlin): Research in instruction and learning; diagnostic competencies of teachers; handling of cultural heterogeneity in the classroom. (CER)



Schaefer, Sabine (Diploma in Psychology, 2001, Free University Berlin; Dr. phil. in Psychology, 2005, Free University Berlin): Cognitive-sensorimotor coordination across the lifespan; age differences in the regulation of sequential action; spatial navigation; behavioral and neural plasticity; ontogenetic changes in behavior regulation. (LIP)



Scheer, Monique (B.A. in History, 1989, Stanford University; M.A. in Empirischer Kulturwissenschaft und Religionswissenschaft, 2000, University of Tübingen; Dr. rer. soc. in Empirischer Kulturwissenschaft, 2005, University of Tübingen): Religious aesthetics of Christianity; history/

anthropology of emotions and of the body; catholic piety, vision cults; history of anthropology and folklore studies. (HoE)



Schellenbach, Michael (Diploma in Computer Science, 2004, Saarland University): Spatial navigation; pedestrian navigation systems; virtual reality. (LIP)



Shing, Yee Lee (M.A. in Educational Psychology, 2003, University of Georgia, Athens; Dr. rer. nat. in Psychology, 2008, Humboldt University Berlin): Lifespan and developmental psychology theories; the

development and plasticity of cognitive mechanisms over the lifespan; multivariate analyses of change and variability; neural correlates of cognitive developmental and aging processes. (LIP)



Schmidt, Anne (First State Examination in History and German language and literature studies, 1998, Free University Berlin; Dr. phil. in Modern History, 2004, University of Bielefeld): History of

advertising and marketing; media and museum studies; cultural studies; history of emotions. (HoE)



Schooler, Lael J. (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)



Schroeder, Sascha (M.A. in Musicology, 2002, University of Cologne; Diploma in Psychology, 2006, University of Cologne; PhD in Psychology, 2008, University of Cologne): Cognitive processes

in language and text comprehension; reading

literacy: assessment of micro- and macro-structural reading skills; research in instruction and learning; quantitative and qualitative methods in empirical research. (CER)



Stevens, Jeffrey R. (PhD in Ecology, Evolution, and Behavior, 2002, University of Minnesota): Cognitive building blocks for cooperative behavior; heuristics for intertemporal choice; evolution of

decision making; comparative aspects of decision making in humans and nonhuman animals; the role of ecological and social context on choice. (ABC)



Verheyen, Nina (M.A. in History and Sociology, 2002, Free University Berlin; PhD in Modern History, 2008, Free University Berlin): Modern European social and cultural history, especially: emotions,

masculinities, media, face-to-face communication. (HoE)



Verrel, Julius (D.E.A in Mathematics, 2001, Jussieu, Paris; M.Sc. in Cognitive Neuroscience, 2006, Radboud University, Nijmegen; Dr. rer. nat. in Psychology, 2010, Humboldt University Berlin): Motor development and aging; interaction of sensorimotor and cognitive skills; movement variability. (LIP)

development and aging; interaction of sensorimotor and cognitive skills; movement variability. (LIP)



Volz, Kirsten G. (Diploma in Psychology, 2001, University of Frankfurt a.M.; Dr. rer. nat., 2004, University of Leipzig): Neural basis/implementation of intuitive decisional processes. (ABC)



Voelkle, Manuel (Dr. rer. soc., 2008, University of Mannheim): Longitudinal research methods; structural equation models; learning and skill acquisition; various aspects of differential psychology; evaluation research. (LIP)

evaluation research. (LIP)



Voss, Thamar (Diploma in Psychology, 2006, University of Marburg; Dr.phil., 2010, Free University Berlin): Research on instruction and learning; teacher research; teacher beliefs. (CER)



Wegwarth, Odette (Diploma in Psychology, 2003, University of Potsdam; Dr.rer.nat. in Psychology, 2007, Humboldt University Berlin): Medical decision making; risk communication in medicine;

patients' and doctors' understanding of risk; influence of transparent medical statistics on patients' and doctors' decision. (Harding Center/ABC)



Werkle-Bergner, Markus (Diploma in Psychology, 2004, Saarland University; Dr.rer.nat., 2009, Humboldt University 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)



Wrzus, Cornelia (Diploma in Psychology, 2005, University of Potsdam; Dr.phil., 2008, University of Potsdam): Development and individual differences in affect and affect regulation; physiological

correlates of affective experiences; assessment and analysis of intraindividual variability. (MPRG Affect)



Zalfen, Sarah (Diploma in Politics, 2004, Free University Berlin; Dr.phil. in Politics, 2010, Free University Berlin): Music and emotions; cultural policy; governance. (MPRG Felt Communities)

Emeritus Members of the Max Planck Society



Edelstein, Wolfgang
(Dr. phil. in Medieval Studies, 1962, University of Heidelberg; Fellow of the Max Planck Society; until 1997 Co-director of the Institute; Dr. h. c. in Social Science, University of Iceland;

Honorary Professor of Educational Science, Free University 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.



Roeder, Peter M.
(Dr. phil., 1960, University of Marburg; Habilitation in Educational Science, 1966, University of Marburg; Fellow of the Max Planck Society; until 1995 Co-director of the

Institute; Special Professor of Educational Sciences, Free University Berlin): Educational sciences; school research; history of educational science.

Max Planck Fellow



Wagner, Gerd G.
(Diploma in Economics, 1978, University of Frankfurt; Dr. rer. oec. in Economics, 1984, Technical University of Berlin; Habilitation in Economics, 1992, Technical University of Berlin):

Research on surveystatistic; research on social risk management; policy advice; teaching of economics.

Adjunct Researchers



Cokely, Edward
(PhD in Cognitive Psychology, 2007, Florida State University): Mechanisms of adaptive and superior performance; judgment and decision making; memory and metacognition;

expertise and individual differences; experimental philosophy and philosophy of mind; morality; intentionality. (ABC)



Lüdtke, Oliver (Diploma in Psychology, 2000, Free University Berlin; Dr. phil. in Psychology, 2004, Free University Berlin; Habilitation in Psychology, 2007, Free University Berlin): Multilevel

analysis; student achievement studies; personality development in adolescence. (CER)



Schmiedek, Florian
(Diploma in Psychology, 2000, University of Mannheim; Dr. phil. in Psychology, 2003, Free University Berlin): Cognitive lifespan psychology;

intra-individual variability; model-based analyses of reaction time distributions; multivariate modeling of cognitive developmental processes. (LIP)



Lövdén, Martin (B.A. in Psychology, 1998, Lund University; PhD in Psychology, 2002, Stockholm University): Lifespan development; cognitive neuroscience of aging; behavioral and neural plasticity;

cognitive control; episodic memory; spatial navigation; sensorimotor-cognition couplings; methods for studying individual change. (LIP)



Rieskamp, Jörg (Diploma in Psychology, 1998, Technical University of Berlin; Dr. phil. in Psychology, 2001, Free University Berlin; Habilitation in Psychology, 2009, Humboldt University Berlin): Cog-

nitive modeling of judgment and decision making; the role of learning in decision making; experimental examinations and evolutionary simulations of simple strategies for social interactions. (ABC)



Trautwein, Ulrich
(Diploma in Psychology, 1999, University of Göttingen; Dr. phil. in Psychology, 2002, Free University Berlin; Habilitation in Psychology, 2005, Free University Berlin): Development

of self-related cognitions in educational settings; school development and management; effects of homework assignment on academic achievement. (CER)

Postdoctoral Fellows



Bailey, Christian (B.A. in Modern History, 2002, University of Oxford; M.A. in Intellectual History and the History of Political Thought, 2003, University of Sussex; M.A., M.Phil. in History, 2006, Yale

University; PhD in History, 2008, Yale University): Intellectual history; history of Europeanization; history of honors systems. (HoE)



Bartling, Karen (Drs. in Psychology, 2006, Maastricht University; Dr. rer. nat. in Psychology, 2010, Humboldt University Berlin): Social and cognitive development in infancy;

physiological correlates of early interaction (ECG, EEG); contingency perception in infancy. (LIP)



Bergert, Bryan (PhD in Psychology, 2008, Indiana University): Empirical and theoretical studies of classification and decision making; improvement of mathematical modeling techniques. (ABC)



Biele, Guido (Diploma in Psychology, 1999, Free University Berlin; Dr. phil. in Psychology, 2006, Free University Berlin): Reward-based decision making; computational modeling; neurocognition of learning and decision making. (MPRG Neurocognition)



Bongrand, Philippe (PhD in Political Science, 2009, Université de Picardie/CNRS, CURAPP; M. Phil. in Sociology, 2002, Paris 5; M.Phil. in Political Science, 2001, Paris 1; B.A. in Sociology, 2001, Paris

5, Faculté des sciences sociales de la Sorbonne; M.A. in Political Science, 2000, Institut d'études politiques de Strasbourg): Schooling policies; history of human sciences; history of childhood and education; empirical methods of the social sciences. (HoE)



Brose, Annette (Diploma in Psychology, 2006, Free University Berlin; Dr. rer. nat. in Psychology, 2009, Humboldt University Berlin): The interaction of stress, emotion, and cognition within and between

individuals across the lifespan; emotion regulation and its developmental trajectories; intraindividual variability and its relation to developmental change. (LIP)



Burzynska, Agnieszka Zofia (B. Sc. in Biotechnology, 2005, University of Gdansk/University of Perugia; M.Sc. in Neuroscience, 2007, University of Göttingen; Dr. rer. nat. in Psychology, 2010, Humboldt University Berlin): Relationships

between brain structure (structural MRI), white matter microstructure (diffusion MRI), brain function (fMRI), and cognitive performance in adult brain. (MPRG Neurocognition/LIP)



Chiang, Yen-Sheng (PhD in Sociology, 2008, University of Washington): Social networks; mechanisms of prosocial behaviors; group decision making; simulation modeling. (ABC)



Conlin, Juliet A. (PhD in Psychology, 2006, University of Durham): Working memory and "executive" processes; decision making across the lifespan; navigational heuristics. (ABC)



Dziobek, Isabel (Diploma in Psychology, 2000, University of Bochum; PhD in Psychology, 2006, University of Bielefeld): Social cognitive neuroscience; autism spectrum conditions; neuroanatomy. (MPRG Neurocognition)



Eppinger, Ben (Dr. phil. in Psychology, 2008, Saarland University): Interactions between motivation and cognitive control across the lifespan; neuroeconomics of aging; age-related changes in reward-based learning and memory. (LIP)



Erol, Merih (M.A. in Sociology, 2001, Bogazici University, Istanbul; PhD in History, 2009, Bogazici University, Istanbul): Late Ottoman social and cultural history; the Greek Orthodox populations of the Ottoman Empire in the 19th and early 20th centuries; music traditions of the Near East and the Balkans. (HoE)



Feufel, A. Markus (Diploma in Engineering [FH], 2003, Stuttgart Media University; M.Sc. in Human Factors Psychology, 2006, Wright State University, Dayton, Ohio; PhD in Human Factors Psychology, 2009, Wright State University, Dayton, Ohio): Bounded rationality in the real world; thick descriptions of functional behavior; support and evaluation of workplace cognition, aiding, and training technologies; societal significance of research efforts and interventions. (Harding Center/ABC)



Filimon, Flavia (PhD in Cognitive Science, 2008, University of California, San Diego): Functional neuroimaging; perceptual decision making; sensorimotor representations; perception for action; brain connectivity. (MPRG Neurocognition)



Freunberger, Roman (Dr. rer. nat. in Psychology, 2008, University of Salzburg): Investigation of cortical oscillations like alpha and gamma rhythms and their functional meaning to atten-

tion, memory, and object recognition; relationship between ERP components, especially the P1 component, and ongoing alpha oscillations. (LIP)



Hämmerer, Dorothea (Diploma in Psychology, 2005, University of Freiburg; Dr.rer.nat. in Psychology, 2009, Humboldt University Berlin): Lifespan differences in performance monitoring functions. (LIP)



judgment and decision making. (ABC)

Karlsson, Linnea (PhD in Psychology, 2008, Umeå University Sweden): Cognitive processes in multiple-cue judgment, the influence of cognitive aging on inference mechanisms, neural correlates to



related processes across the lifespan; age differences in cooperative behavior; individual differences and context covariates underlying interpersonal interactions; subjective experience of own aging. (LIP)

Kleinspehn-Ammerlahn, Anna (Diploma in Psychology, 2004, Free University Berlin; Dr.phil. in Psychology, 2008, Free University Berlin): Development of emotional and self-



19th and 20th century; history of ethnology/anthropology and medicine; history of human experiment; race- and cultural theories; history of visualization; history of medical films. (HoE)

Laukötter, Anja (M.A. in Modern History, 2001, Humboldt University Berlin; Dr.phil. in Modern History, 2006, Humboldt University Berlin): Cultural history and the history of knowledge in the



Le Lec, Fabrice (PhD in Economics, 2007, GREQAM, University of Aix-Marseille): Behavioral/experimental economics; behavioral game theory; bounded rationality; economics

and philosophy; decision under uncertainty. (ABC)



of the environment and cognitive processes; strategy and heuristic selection; strategies and heuristics in inference and choice; ease of retrieval, fluency, and recognition in decision making; methods for quantitative model testing, ACT-R modeling; heuristic and intuitive decision processes in management and consumer choice; judgments and intuitions about fairness, responsibility, and morality in business. (ABC)

Marewski, Julian N. (Diploma in Psychology, 2005, Free University Berlin; Dr.phil., 2009, Free University Berlin): Bounded rationality, heuristics, memory; quantitative modeling of the interplay



judgment and decision making; models of bounded rationality and heuristic inference models of information search. (ABC)

Meder, Björn (Diploma in Psychology, 2003, University of Göttingen; Dr.rer.nat., 2006, University of Göttingen): Causality and causal cognition, categorization, and inductive learning;



finance and healthcare; heuristics based decision support systems; business analytics and semantics technologies. (ABC)

Monti, Marco (PhD in Economics, Bocconi University, Milan): Behavioral and experimental economics; heuristics in investor decision making; trust formation and risk communication in



development of inference abilities. (LIP)

Morais, Ana Sofia (Dr.rer.nat. in Psychology, 2010, Humboldt University Berlin): Semantic memory organization; categorization and causal learning; judgment and decision making; lifespan



havior; age-related changes in the human brain (structure, functional activation, dopamine system); using fMRI (functional magnetic resonance imaging) to examine the interplay of increasing age, genetic predisposition, brain structure, and task-specific brain activation patterns, and their relation to cognitive decline in the elderly. (LIP)

Nagel, Irene E. (Diploma in Psychology, 2005, Maastricht University; Dr.rer.nat. in Psychology, 2009, Humboldt University Berlin): Age-related changes in human cognition and be-



Public Health [DrPH], 2008, University of Bielefeld): Risk communication in public health; risk literacy; statistical literacy; medical decision making; evidence-based medicine and public health. (ABC)

Neumeier-Gromen, Angela (License to practice medicine [MD], 1998, Humboldt University Berlin; Master of Public Health [MPH], 2002, Technical University of Berlin; Doctor of



of British Columbia; PhD in History, 2009, McGill University): Modern British social and cultural history; gender and family history; history of childhood and youth; history of education and religion. (HoE)

Olsen, Stephanie (I.B., 1997, Lester B. Pearson United World College of the Pacific; B.A. [Hons.] in International Studies, 2001, York University [Glendon College]; M.A. in History, 2003, University



ology; computational modeling. (MPRG Neurocognition)

Piliastides, Marios G. (PhD in Biomedical Engineering, 2007, Columbia University, New York): Neural correlates of perceptual and reward-based decision making; methods in human electrophysiology; computational modeling. (MPRG Neurocognition)



Preuschhof, Claudia (Diploma in Psychology, 2003, Humboldt University Berlin; PhD in Psychology, 2008, Humboldt University Berlin): Episodic and working memory and imaging genetics; somatosensory system. (MPRG Neuro-cognition)



Simsek, Özgür (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; complex networks. (ABC)



Studtmann, Markus (Diploma in Psychology, 2003, University of Bielefeld; Dr.phil. in Psychology, 2009, University of Greifswald): Emotional development across adulthood; facial expressions of emotion; perceived versus actual emotional behavior (MPRG Affect)



Vidor, Gian Marco (Joint PhD in Modern History and Anthropology, 2008, Université de Versailles Saint-Quentin-en-Yvelines [F] and Scuola Internazionale in Scienze della Cultura, Fondazione Collegio San Carlo, Modena [I]): History of emotions; history and anthropology of dying, death, and bereavement; history of 19th and 20th century; urban history. (HoE)

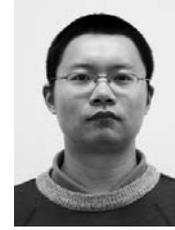


Wassmann, Claudia (3. Staatsexamen Humanmedizin [Medical Degree], 1988, Free University Berlin; Dr.med., 1990, University of Düsseldorf; PhD in History, 2005, University of Chicago): History and philosophy of the emotions; history of medicine and the neurosciences; modern European social and cultural history, especially Germany and France; film and media studies. (HoE)



Wolf, Max (PhD in Theoretical Biology, 2009, University of Groningen [NL]): Causes and consequences of variation; ecology and evolution of individual differences; physiological and cogni-

tive mechanisms underlying decision making; simple heuristics. (ABC)



Zhu, Wei (PhD in Urban Planning, 2008, Eindhoven University of Technology): Econometric models of human decision making; choice of decision strategies; pedestrian behavior in urban environments. (ABC)

Predocctoral Fellows



Antony, Jose (M.Sc. in History, 2008, University of Edinburgh): Political and cultural history of modern South Asia; emotions, religious experience, and nationalism; Shaivism; Vaishnavism; Islam, Bhakhi movement and Sufi movement. (HoE)



Artinger, Florian (M.Sc. in Economics and Management Science, 2006, Humboldt University Berlin): Behavioral economics; fast & frugal heuristics in strategic interaction; methods: lab & field experiments, simulations. (ABC)



Bache, Cathleen (Diploma in Psychology, 2008, Humboldt University Berlin): Socio-cognitive development in infancy; physiological correlates of early social interaction (EEG, ECG); joint action in infants and adults. (LIFE/LIP)



Besser, Michael (First State Examination in Mathematics and German, 2007, University of Kassel): Research on "teacher expertise"; content knowledge and pedagogical content knowledge of mathematics teachers. (CER)



Biermann, Tim (M.A. in History, 2010, University of Bielefeld): History of music and emotions; cultural studies; theory of history. (MPRG Felt Communities)



Bodemer, Nicolai (Diploma in Psychology, 2009, University of Mannheim): Risk perception/risk communication; risk literacy; medical decision making; consumer behavior; meta-analysis. (ABC)



Brandmaier, Andreas (Diploma in Informatics, 2008, Technical University of Munich): Machine learning and data mining; analysis of multidimensional time-series and synchronicity; statistical modeling; computer algorithms in psychology; formal modeling. (LIP)



Donauer, Sabine (B.A. in European Cultural History, 2006, University of Augsburg; M.A. in European History and Civilization, 2007, University of Leiden; M.A. in Higher Education, 2009, Harvard University): History of science; cultural history of Germany (19th and 20th century); history of emotions; labor history. (HoE)



Engster, Bettina (M.A. in Literature, History and Educational Sciences, 2007, University of Bielefeld): Emotions and their representation in Indian mainstream cinema. (HoE)



Fandakova, Yana (Diploma in Psychology, 2008, Humboldt University Berlin): Memory development and its neuronal correlates; age differences in episodic memory; episodic memory development across the lifespan; multivariate modeling of variability and change; functional and structural neuroimaging. (LIFE/LIP)



(ABC)

Fleischhut, Nadine (M.A. in Analytical Philosophy, 2006, Free University Berlin): Heuristics in social interaction; social and ecological rationality; moral judgment and decision making.



languages and literatures. (HoE)

Freier, Monika (M.A. in Indian Studies/German Literature, 2005, University of Hamburg): Advice and travel literature in Hindi; social history of emotions; intercultural studies; modern South Asian



change. (LIP)

Grandy, Thomas (Diploma in Psychology, 2006, Free University Berlin): Oscillatory networks in the human EEG across the lifespan; EEG methods; neuronal correlates of lifespan plasticity and



cognitive modeling; developmental neuroscience; decision making. (MPRG Neurocognition)

Green, Nikos (B.Sc. in Cognitive Science, 2004, University of Osnabrück; M.Sc. in Cognitive Science, 2006, University of Amsterdam): Cognitive science; cognitive neuroscience; computational and



search. (LIFE/CER)

Gresch, Cornelia (Diploma in Social Sciences, 2004, University of Mannheim): Social origin and educational career decisions; ethnic disparities; quantitative methods of empirical social re-



Hachfeld, Axinja (Diploma in Psychology, 2006, Free University Berlin): Teacher beliefs; beliefs toward cultural heterogeneity in the classroom. (CER)



Jednoralski, Dominik (Master of Science, 2010, Saarland University): Lifespan technologies; ubiquitous and pervasive computing; artificial intelligence. (LIP)



Kämmer, Juliane (Diploma in Psychology, 2009, Humboldt University Berlin): Heuristics in group decision making; social and ecological rationality; determinants of the perception of expertise. (ABC)

(ABC)



Kleemeyer, Maike (B.Sc. in Cognitive Science, 2007, University of Osnabrück; M.Sc. in Neurosciences, 2010, University of Bremen): Interaction of cognitive and motor skills across the lifespan; neuroplasticity; EEG-method. (LIP)

(LIP)



Kliemann, Dorit (Diploma in Psychology, 2008, University of Bremen): Cognitive neuroscience; social decision making in healthy controls and individuals on the autism spectrum; functional and structural neuroimaging. (MPRG Neurocognition)

(MPRG Neurocognition)



Klipker, Kathrin (Diploma in Psychology, 2010, University of Bochum): Affect cognition links over the lifespan; affective variability from late childhood to early adulthood. (LIFE/MPRG Affect)



Lohse, Hendrik (Diploma in Psychology, 2009, Humboldt University Berlin): University teacher education; teacher goal orientations; contributions of subject-matter experts in the development

of psychometric tests; athletic talent identification and development. (CER)



Mohr, Peter N. C. (M.Sc. in Business Administration, 2006, University of Munster): Economic decision making; risk perception. (LIFE/MPRG Neurocognition)



Multmeier, Jan (Diploma in Psychology, 2008, University of Bielefeld): Risk perception; risk communication; medical decision making. (ABC)



Noack, Hannes (Diploma in Psychology, 2007, University of Potsdam): Behavioral and brain plasticity. (LIP)



Papenberg, Goran (Diploma in Psychology, 2009 Humboldt University Berlin): Neuromodulation of episodic memory across the lifespan; intraindividual variability. (LIFE/LIP)



Passow, Susanne (Diploma in Psychology, 2007, Humboldt University Berlin): Neuropsychology in aging; neurodegenerative diseases; age differences in attentional control of auditory verbal percep-

tion; developmental changes in the func-

tional organization of the auditory cortex. (LIP)



Pipergias Analytis, Pantelis (M.A. in Cognitive Science, 2009, EHESS Paris): Fast and frugal heuristics; signaling theory; metacognitive uncertainty. (ABC)



Prestel, Joseph Ben (B.A. in History and Political Science 2008, Free University Berlin; M.A. in Modern History, 2010, Free University Berlin): History of emotions; urban studies; global history; cities in the 19th century. (HoE)



Richter, Dirk (M.A. in Quantitative Research, Evaluation and Measurement in Education, 2005, The Ohio State University; M.A. in Education, 2006, Dresden Technical University; Dr. phil. in Education, 2010, Free University Berlin): Teacher education; teacher testing; professional development of teachers, teacher mentoring; statistical modeling. (LIFE/CER)



Ruggeri, Azzurra (M.A. in Philosophy, 2008, University of Pisa): Development of strategies across the lifespan; children decision making; strategies selection process; philosophy of mind. (ABC)



Sajjad, Mohammad (M.Phil, M.A. in Indian History, Jamia Millia Islamia, New Delhi): Indian history (late medieval and early modern period); Sufism in India; Muslims in India: religion, society and culture (17th–19th centuries). (HoE)



Sander, Myriam C.
(Diploma in Psychology, 2007, Humboldt University Berlin): Development of perception and memory across the lifespan; neural correlates of developmental change and brain

plasticity; EEG methods. (LIP)



Sanger, Johanna
(Diploma in Psychology, 2009, University of Konstanz): Neuronal mechanisms of interpersonal action coordination; cortical synchronization; EEG hyperscanning. (LIFE/LIP)



Schleyer, Maritta
(M.A. in Modern South Asian Languages and Literature, Cultural and Religious History of South Asia, Anthropology, 2008, University of Heidelberg): History of

Muslims in South Asia; Urdu literature. (HoE)



Shah, Nadeem
(M.Phil., 2004, Centre for Historical Studies, Jawaharlal Nehru University): Sufi orders, medieval and early modern Urdu and Persian texts, medieval and early modern Indian socio-

political issues; music and poetry in the late 18th and early 19th century India. (HoE)



Spallek, Anabelle
(M.A. in History, 2009, University of Hamburg): Cultural history of music reception; modern European social history; citizenship studies. (MPRG Felt Communities)



Stormer, Viola (M.A. in Psychology, 2008, Humboldt University Berlin): Cognitive and neural mechanisms of perception, selective attention, and multisensory processing; age-related changes in

visual attention and working memory processes. (LIFE/LIP)



Timm, Franziska
(M.A. in Educational Science, 2007, University of Potsdam): Philosophy of education and history of education; sociology; history of emotions. (HoE)



Volstorf, Jenny (Diploma in Psychology, 2006, University of Chemnitz): cognitive prerequisites for the emergence of cooperation; evolutionary simulations. (ABC)



Wellmann, Henning
(Diploma in Political Sciences and Cultural Sciences, 2009, University of Bremen): Music and emotions; cultural studies; poststructuralist theory. (MPRG Felt Communities)



Wenger, Elisabeth
(Diploma in Psychology, 2010, Free University Berlin): Brain plasticity across the lifespan; timing and functional nature of anatomical brain changes; structural neuroimaging. (LIFE/

LIP)



Wenzlaff, Hermine
(Diploma in Biology, 2005, University of Tubingen): Neurobiology of perceptual decision making; electrophysiological recording (EEG, MEG); cognitive modeling; correlation

of neurophysiological components with modeled parameters. (MPRG Neurocognition)



Wolff, Julia K. (Diploma in Psychology, 2008, University of Jena): The interplay of social support, well-being, health, and health behavior in younger and older adults; intraindividual variability and

its development over the lifespan. (LIFE/LIP)

9. Where Have Our Researchers Gone? New Positions 2009–2010

Researchers

Becker, Michael 2010, University of Potsdam, Research Associate
Eifert, Christiane 2010, Free University Berlin, Researcher
El-Khechen (Abou-Saleh), Wahiba 2010, Technical University of Dortmund, PhD-Scholar
Heekeren, Hauke R. 2010, Free University Berlin, Professor of Affective Neuroscience and Psychology of Emotions
Jonkmann, Kathrin 2010, University of Tübingen, Juniorprofessor in Educational Sciences
Julius-McElvany, Nele 2010, Technical University of Dortmund, Full Professor
Kleickmann, Thilo 2010, University of Kiel, Researcher
Klusmann, Uta 2010, University of Kiel, Juniorprofessor
Kruse, Imke 2010, Max Planck Society, Munich, Head of Section Office (HS)
Kunina-Habenicht, Olga 2010, University of Frankfurt a. M., Researcher
Kunter, Mareike 2010, University of Frankfurt a. M., Professor for Educational Psychology
Kurz-Milke, Elke 2009, University of Education, Ludwigsburg, Researcher
Lohse, Hendrik 2010, University of Frankfurt a. M., Researcher
Maaz, Kai 2010, University of Potsdam, Chair of Quantitative Methods in Education
Michl, Susanne 2009, University of Greifswald, Researcher
Milek, Anne 2009, German Sport University Cologne, Researcher
Nagy, Gabriel 2010, University of Tübingen, Juniorprofessor in Educational Sciences
Neumann, Marko 2010, University of Potsdam, Research Associate
Rjosk, Camilla 2010, Institute for Educational Progress, Berlin, Researcher
Schroeder, Sascha 2010, University of Kassel, Researcher
Verheyen, Nina 2010, University of Vienna, Austria, Researcher
Volz, Kirsten G. 2010, University of Tübingen, Head of Junior Research Group

Postdoctoral Fellows

Bailey, Christian 2010, Balliol College, UK, Researcher
Biele, Guido 2009, Free University Berlin, Researcher
Brose, Annette 2010, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Postdoctoral Fellow
Chiang, Yen-Sheng 2009, University of California–Irvine, USA, Assistant Professor
Dziobek, Isabel 2009, Free University Berlin, Head of Junior Research Group
Filimon, Flavia 2010, Free University Berlin, Postdoctoral Fellow
Karlsson, Linnea 2010, Umeå University, Sweden, Senior Postdoctoral Scientist
Kleinspehn-Ammerlahn, Anna 2010, Hannover Medical School
LeLec, Fabrice 2010, Catholic University of Lille, France, Researcher
Monti, Marco 2010, Catholic University of Sacred Heart of Milan, Italy
Nagel, Irene 2010, Free University Berlin, Researcher
Neumeyer-Gromen, Angela 2009, German Hospital Federation (DKG), Berlin
Philiastides, Marios G. 2010, Free University Berlin, Postdoctoral Fellow
Preuschhof, Claudia 2009, Free University Berlin, Researcher
Zhu, Wei 2010, Tongji University, Shanghai, China, Lecturer

Predoctoral Fellows

Besser, Michael 2009, University of Kassel, Researcher

Green, Nikos 2010, Free University Berlin, Researcher

Gresch, Cornelia 2010, Social Science Research Center Berlin, Researcher

Kliemann, Dorit 2009, Free University Berlin, Researcher

Lohse, Hendrik 2009, University of Frankfurt a.M., Researcher

Mohr, Peter N. C. 2009, Free University Berlin, Researcher

Richter, Dirk 2010, Institute for Educational Progress, Berlin, Researcher

Wenzlaff, Hermine 2009, Free University Berlin, Researcher

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 education, history, and psychology, 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 for Human Development is one of about 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 subsequently by Friedrich Edding (1964), Dietrich Goldschmidt (1964), and Saul B. Robinsohn (1964) as the first generation of scientific directors. In the first decade of its existence, the development of educational research and educational policy was emphasized.

The appointment of a second generation of directors (Wolfgang Edelstein, 1973, and Peter M. Roeder, 1973) added to this framework a commitment to 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 concentrated more and more on questions of basic research associated with the nature of human development, education, and work in a changing society. At the same time, life-span developmental and life-course research were added as a signature profile of the Institute's research program.

Latest developments in the succession of generations were marked by the appointment of Ulman Lindenberger as new director of the Center for Lifespan Psychology (2004), adding an emphasis on neural correlates of human behavior and cognitive plasticity, and by the appointment of Ute Frevert as director of the newly established Center for the History of Emotions (2007), adding perspectives from cultural history to the Institute's research agenda on human development.



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