Max Planck Research Group

Affect Across the Lifespan

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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

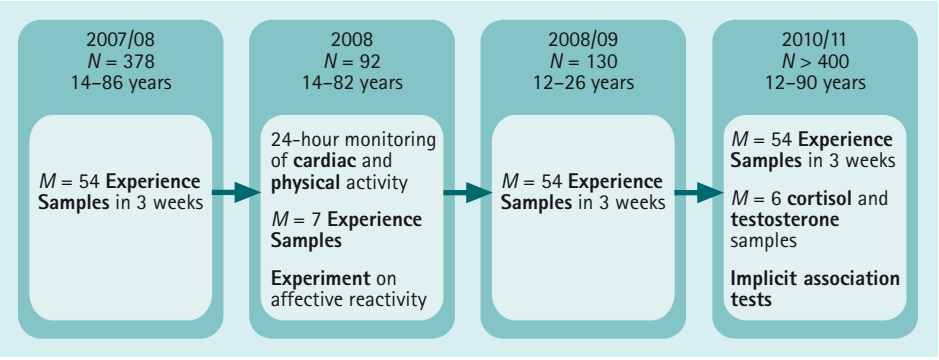

Figure 1. Overview of the longitudinal MMAA Project. Between 2007 and 2010, four assessment phases have been conducted in a sample ranging in age from adolescence to old adulthood. New participants, and young adolescents in particular, have been regularly recruited to maintain the age composition of 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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Riediger, M. (2010). Experience sampling. In German Data Forum (RatSWD) (Ed.), *Building on progress: Expanding the research infrastructure for the social, economic, and behavioral sciences* (Vol. 1, pp. 581–594). Opladen: Budrich UniPress.

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 biomonitoring of cardiac activity (assessed via 24-hour electrocardiography), physical activity (assessed via 24-hour accelerometry), and hormonal processes (assessed via repeated ambulatory saliva samples). 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.

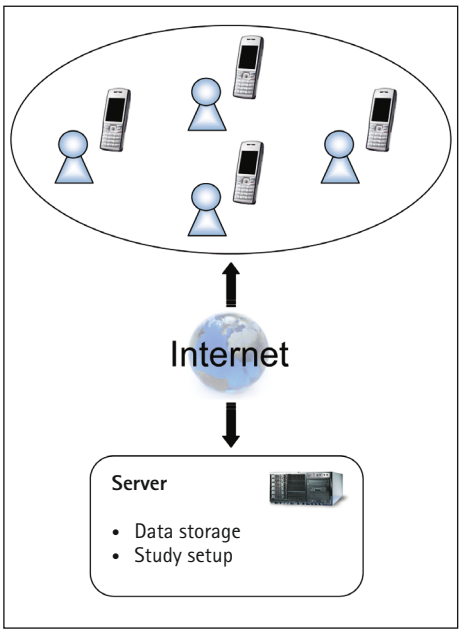

Figure 2. Using mobile phones to sample experiences in day-to-day life. Participants are provided with mobile phones that they carry with them at all times while pursuing their daily routines. On these phones, a testing software is installed that controls the participants' assessment schedule and that 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.

On an average of eight and a half months later, we continued this project using an ambulatory biomonitoring 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 biomonitoring 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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Riediger, M., Schmiedek, F., Wagner, G. G., & **Lindenberger, U.** (2009). Seeking pleasure and seeking pain: Differences in prohedonic and contra-hedonic motivation from adolescence to old age. *Psychological Science, 20,* 1529–1535. doi: 10.1111/j.1467-9280.2009.02473.x

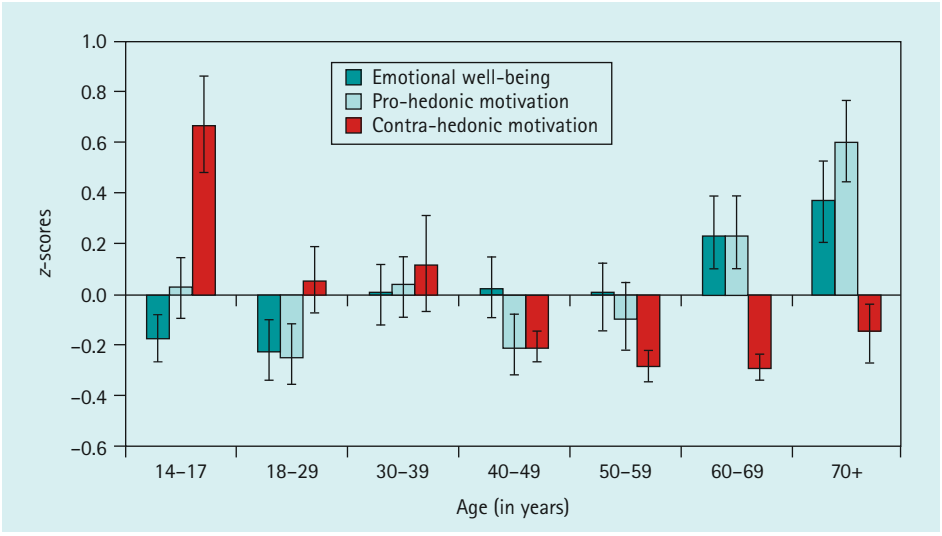

Figure 3. Age differences in regulatory orientations mirror age differences in everyday emotional well-being. Using a mobile-phone based experience-sampling technology in 378 individuals ranging from 14 to 86 years of age, we investigated age differences in emotional well-being and in how people want 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.

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 prohedonic 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-

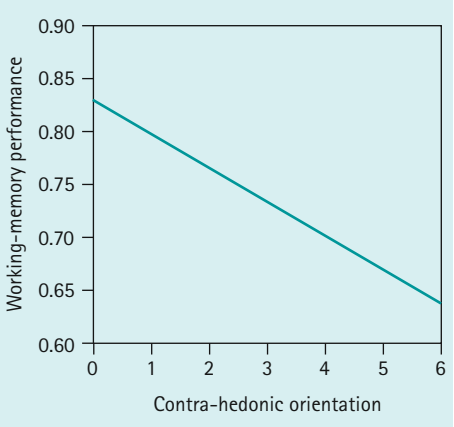

Figure 4. Associations of contra-hedonic orientation and working-memory performance in day-to-day life. The more contra-hedonic orientation participants reported, the lower was their working-memory capacity. Model predictions from multilevel regressions controlling for positive and negative affect, prohedonic orientation, and session number.

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 reactivity 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.

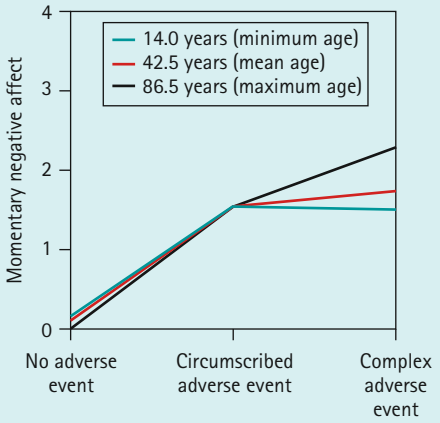

Figure 5. Age differences in affective reactivity to adverse events depend on the complexity of the situation. Several times a day throughout 3 weeks, participants reported the occurrence of adverse events and their momentary negative affect. After circumscribed adverse events, which concerned one life 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.

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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Riediger, M., Voelkle, M. C., Ebner, N. C., & **Lindenberger, U.** (in press). Beyond "happy, angry, or sad?" Age-of-poser and age-of-rater effects on multidimensional emotion perception. *Cognition and Emotion.*

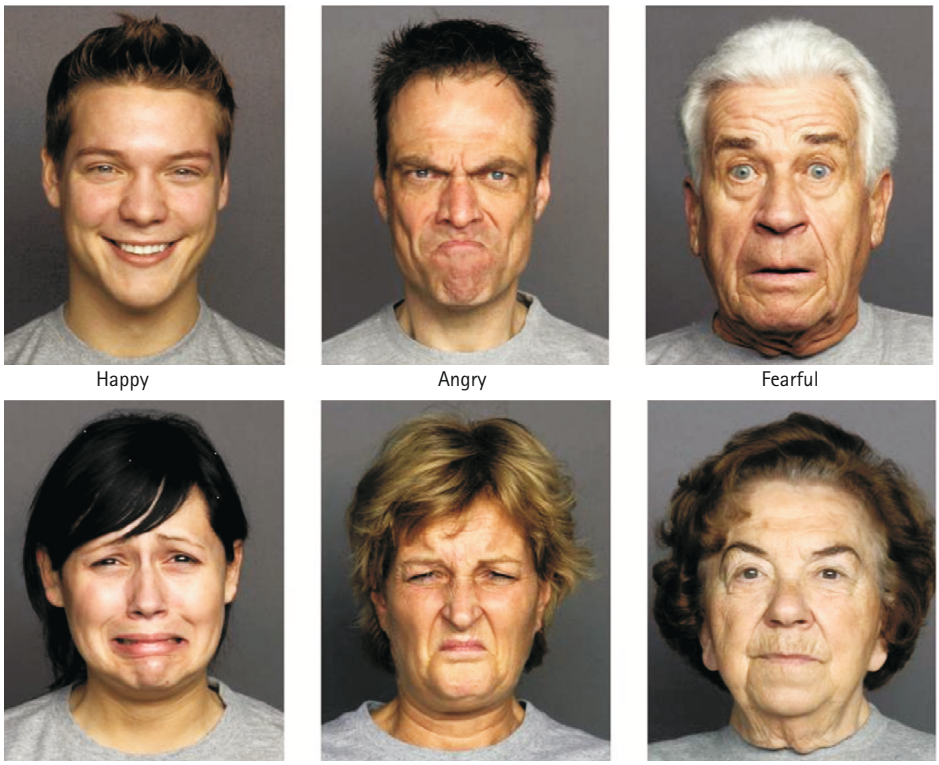

Figure 6. Sample expressions from the FACES Lifespan Database of Facial Expressions. FACES contains 2,052 photographs of facial expressions from 171 young, middle-aged, and older men and women. For each depicted person, the database provides two sets of six pictures each showing five emotional and one neutral expression. The unique feature of this database is that it systematically varies emotional expressions within persons stemming from different age groups.

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 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.

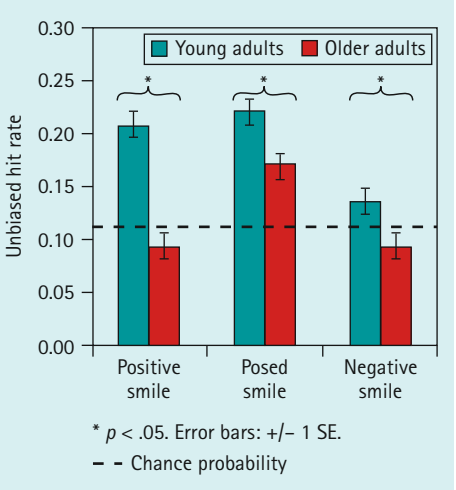

Figure 7. Younger adults are better in reading smiles than older adults. Younger adults were more accurate than older adults in identifying emotional experiences accompanying positive, nonemotional, and negative smiles.

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

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,

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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.

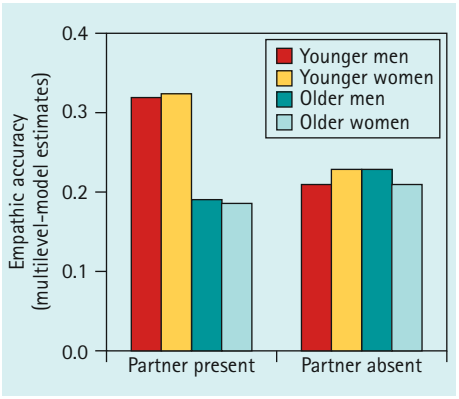

Figure 8. Differences between younger and older adults' knowledge of their partner's affect depend on the presence or absence of the partner. Experience-sampling data were obtained from cohabitating couples' daily lives. Participants simultaneously rated their own and their partner's current affect. 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.

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, 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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