

Kunzmann, Ute; Richter, David; Schmukle, Stefan C.

Article — Accepted Manuscript (Postprint)

Stability and Change in Affective Experience Across the Adult Life Span: Analyses With a National Sample From Germany

Emotion

Provided in Cooperation with:

German Institute for Economic Research (DIW Berlin)

Suggested Citation: Kunzmann, Ute; Richter, David; Schmukle, Stefan C. (2013) : Stability and Change in Affective Experience Across the Adult Life Span: Analyses With a National Sample From Germany, *Emotion*, ISSN 1528-3542, American Psychological Association, Washington D.C., Vol. 13, Iss. 6, pp. 1086-1095, <https://doi.org/10.1037/a0033572>

This Version is available at:

<https://hdl.handle.net/10419/93010>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

This article may not exactly replicate the final version published in the APA journal. It is not the copy of record. The final published version is available at <http://psycnet.apa.org/doi/10.1037/a0033572>

Stability and Change in Affective Experience across the Adult Life-Span:

Analyses with a National Sample from Germany

Ute Kunzmann¹, David Richter², & Stefan C. Schmukle¹

Author Note

Ute Kunzmann and Stefan C. Schmukle, Institute of Psychology, University of Leipzig, David Richter, German Institute for Economic Research, Berlin

Correspondence: Ute Kunzmann or Stefan C. Schmukle, Institute of Psychology, University of Leipzig, Seeburgstrasse 14-20, 04103 Leipzig or David Richter, German Institute for Economic Research, Mohrenstraße 58, 10117 Berlin. The data used in this publication were made available to us by the German Socio-Economic Panel Study (data for years 1984-2011, Version 28, 2012) at the German Institute for Economic Research, Berlin, Germany. Emails: kunzmann@uni-leipzig.de, drichter@diw.de, schmukle@uni-leipzig.de.

Key words: emotion, affect, sadness, anger, happiness, aging, adult life-span, longitudinal change

Abstract

Using cross-sectional and longitudinal data from a national sample spanning the adult life-span, age differences in anger and sadness were explored. The cross-sectional and longitudinal findings consistently suggest that the frequency of anger increases during young adulthood, but then shows a steady decrease until old age. By contrast, the frequency of sadness remains stable over most of adulthood and begins to increase in old age. In addition, the effects of age on happiness were investigated; the cross-sectional evidence speaks for a steady decrease in happiness across age groups, but within-person decline in happiness was only evident in old age. Together the findings provide further evidence for multidirectional age differences in affective experience and suggest that the overall quality of affective experience may deteriorate in old age.

Stability and Change in Affective Experience across the Life-Span:

Analyses with a National Sample from Germany

Past field studies interested in the effects of age on affective experience have focussed on two global affective dimensions (i.e., positive affect and negative affect) rather than on discrete emotions (e.g., anger, sadness, joy). Most of the studies have been interested in people's global judgments of affect frequency. Findings from these studies suggest that, despite the age-related increase in losses and other negative events, negative affect does not increase with age, but remains stable (e.g., Bradburn, 1969; Diener & Suh, 1997; Mroczek & Kolarz, 1998) or even decreases (e.g., Charles, Reynolds, & Gatz, 2001; Stacy & Gatz, 1991). Although the evidence for age differences in positive affect is somewhat more mixed, the findings from many studies tell a similar story, namely, positive affect does not decline with age, but remains stable (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Carstensen et al., 2011; Gross et al., 1997) or even increases (e.g., Mroczek & Kolarz, 1998). Together these findings have been taken to suggest that the overall quality of emotional experience steadily improves during the adult life-span, at least until advanced old age during which negative affect may begin to increase and positive affect declines (e.g., Carstensen et al., 2000; Charles et al., 2001; Kunzmann, Little, & Smith, 2000; Kunzmann, 2008).

In this study, our first goal was to provide a more fine-grained analysis of age differences in negative affect by adopting a discrete emotions approach and by focussing on two distinct negative emotions: anger and sadness. A secondary goal was to analyze age differences in happiness which can be considered one facet of the broader concept of positive affect that also includes other positive emotions (e.g., pride, interest, or satisfaction).

Age Differences in Negative Affect: The Sample Case of Anger and Sadness

Past age-comparative field studies interested in the frequency of negative affect have not separately investigated discrete emotions such as anger and sadness. However, laboratory

studies interested in the intensity of emotional reactions to standardized stimuli have provided initial evidence for multidirectional age differences in these two emotions. For example, when confronted with complex emotion-elicitors such as film clips of an old woman talking about problems in a nursing home (Charles, Carstensen, & McFall, 2001) or audio-taped conversations, in which two individuals were ostensibly making disparaging remarks about a third person (Charles & Carstensen, 2008), older adults reported less anger than their younger counterparts, whereas age differences in sadness-reactions were nonsignificant or even reversed. In a study examining age differences in affective experience during social conflict, older adults were also shown to report less anger than young adults (Birditt & Fingerman, 2005). Other studies have investigated age differences in emotional reactions to stimuli specifically designed to elicit either anger or sadness (e.g., Kunzmann & Grühn, 2005; Kunzmann & Richter, 2009; Labouvie-Vief, Lumley, Jain, & Heinze, 2003; Seider, Shiota, Whalen, & Levenson, 2010; Streubel & Kunzmann, 2011; Tsai, Levenson & Carstensen, 2000). In this work, in comparison with their younger counterparts, older adults reported less anger in response to anger-stimuli, but equal or higher sadness in response to sadness-stimuli.

Why should only anger decrease with age, whereas sadness remains stable or even increases? As will be elaborated below, one explanation refers to the idea that each stage in the life cycle (e.g., young adulthood, old age) is typified by a specific configuration of environmental challenges as well as personal needs, beliefs, and future expectations that makes the experience of certain emotions more likely than the experience of other emotions (see also Haase, Seider, Shiota, & Levenson, 2012; Kunzmann & Grühn, 2005).

To this end, young adulthood has been described as a phase of growth during which individuals have great opportunities to develop their potentials; thus, processes of optimization rather than maintenance or compensation have priority (Baltes & Baltes, 1990; Ebner, Freund, & Baltes, 2006). Consistent with this view, Socioemotional Selectivity Theory (SST; Carstensen, 2006) states that young adults' goals tend to be future-oriented and

focused on acquiring new resources such as knowledge or information (e.g., Carstensen, Isaacowitz, & Charles, 1999). Moreover, life-span theories of control (e.g., Brandtstädter & Greve, 1994; Heckhausen, Wrosch, & Schulz, 2010) have proposed that, in young adulthood, perceptions of high personal control and a tenacious goal pursuit are not only highly prevalent, but also intimately tied to higher well-being (e.g., Lachman, 2006; Rothermund & Brandtstädter, 2003; Wrosch & Heckhausen, 1999). Finally, there is evidence suggesting that individuals are most willing to engage in social conflicts when they are young (e.g., Birditt, Fingerman, & Almeida, 2005; Blanchard-Fields, Seay, & Mienaltowski, 2007; Charles & Carstensen, 2008).

Given that, relative to older adults, young adults pursue many future-related goals and have a strong need to accomplish them, the elicitor of anger, that is, the appraisal that one's own goals are intentionally ignored or blocked by others, should be more frequent and salient (i.e., easily elicited). In addition, the situational control appraisals, action tendencies, and social motivations typical of anger are likely to be more readily accessible in young adulthood than in old age. More specifically, according to discrete emotion theories, anger prototypically involves the belief in high situational control (Lazarus, 1991), triggers a reactant "moving against" state of action readiness (Frijda, Kuipers, & ter Schure, 1989), and promotes persistence (Lench & Levine, 2008). In addition, anger facilitates efforts to bring back others' behavior in line with one's own goals (Fischer & Roseman, 2007). Thus, relative to older adults, young adults should experience anger more intensively and more frequently.

In marked contrast to young adulthood, old age has been characterized as a phase of loss (Baltes & Mayer, 1999; Lindenberger & Baltes, 1997; Smith & Baltes, 1997) during which social, cognitive, and physical resources become increasingly limited and processes of maintenance and compensation gain importance (Baltes & Baltes, 1990). Life-span theories of control have proposed that, given the limited resources in old age, perceptions of low personal control and flexible goal adjustment become increasingly frequent and can even be adaptive

(e.g., Lachman, 2006; Rothermund & Brandtstädter, 2003; Wrosch & Heckhausen, 1999). In addition, according to SST, because future life-time shrinks with increasing age, older adults' goals tend to be present-oriented and focused on making meaningful experiences (Carstensen, 2006). Consistent with this notion, older adults appear to be particularly likely to avoid social conflicts for the sake of social harmony in the current moment (e.g., Birditt et al., 2005; Blanchard-Fields, 2007).

Given that, relative to young adults, older adults increasingly face fundamental losses and tend to flexibly adjust their goals accordingly, the elicitor of sadness, that is, the construal of a situation as irreversible loss, should be more frequent and salient (i.e., easily elicited). In addition, the situational control appraisals, action tendencies, and social motivations that are linked to sadness are likely to be more readily accessible in old age than in earlier life periods. More specifically, according to discrete emotion theories, sadness prototypically goes hand in hand with a belief in low situational control (Lazarus, 1991). It triggers processes of goal disengagement (Frijda et al., 1989) and signals to others the need for closeness, sympathy, and support (Andrews & Thompson, 2009). As a consequence, relative to young adults, older adults should experience sadness more intensively and frequently.

Age Differences in Positive Affect: The Sample Case of Happiness

It is generally acknowledged that positive affect is made up of many positive emotions, including interest, serenity, pride, and happiness. Although these positive emotions may not be called specific or discrete in terms of facial expressions or autonomic responding (e.g., Ekman, 1992; Levenson, 1992), they are still distinct in that they occur in different situational contexts and are associated with different classes of behaviors (e.g., Fredrickson, 1998). In this study, our focus was on one important facet of positive affect, that is, happiness. According to the Circumplex Model of Affect proposed by Watson and his colleagues (e.g., Tellegen, Watson, & Clark, 1999), happiness is characterized by moderate levels of arousal. It is often used interchangeably with joy (e.g., Lazarus, 1991) and shares conceptual space with

amusement, gladness, and elation. Happiness is a hedonic feeling that is often elicited by events construed as accomplishments or progress toward one's goals (Izard, 1977; Lazarus, 1991). Given that losses become increasingly prevalent with age (e.g., Baltes & Mayer, 1999) and given that a constructive management of such losses increasingly involves disengagement from once valued goals (e.g., Heckhausen et al., 2010), we expect a negative association between age and happiness.

The Present Study

A first goal of this study was to investigate age differences in the frequency of anger and sadness in the context of a nationally representative panel study that includes diverse age ranges. As discussed, current evidence for multidirectional age differences in anger and sadness is limited to age-comparative laboratory studies interested in the intensity of anger and sadness in reaction to a given set of stimuli (i.e., in reaction to events that cannot be avoided by the individual; e.g., Charles & Carstensen, 2008). Affect frequency reflects how often individuals are confronted with such events. For example, some older individuals may experience relatively few losses, but if confronted with a loss, they might experience sadness very intensively. Thus, affect intensity and affect frequency certainly are two distinct aspects that should be studied separately (e.g., Schimmack, Oishi, Diener, & Suh, 2000). Proceeding from the evidence that losses (the elicitors of sadness) generally increase with age and assuming that sadness-specific appraisals, action tendencies, and social motivations become increasingly salient with age, however, we predicted that, relative to young adults, older adults should experience sadness not only more intensively but also more frequently. The opposite should be true for anger; proceeding from the evidence that, relative to older adults, young adults pursue many goals and have a strong need to accomplish them, the elicitor of anger (a blocked goal) should become be more likely and the anger-associated appraisals, action tendencies, and social motivations more salient. As a consequence, relative to older adults, young adults should experience anger more frequently.

A secondary goal was to analyze age differences in the frequency of happiness which can be considered one facet of positive affect. Given that happiness is an evaluative positive emotion that is often elicited during goal pursuit and attainment, we predicted a negative association between age and happiness.

For two reasons, the present study was ideally suited to test our predictions. First, the study used information from a representative German national sample. As a consequence, the sample was larger and more heterogeneous than many of the samples investigated in past work interested in age and emotion. In addition, the present sample's age range was comparatively broad, covering the entire adult life-span (age range 18 to 87 years).

Second, in this study, sadness, anger, and happiness were assessed five times on a yearly basis, starting in 2007 and enabling us to analyze the effects of age on affective experiences at the first wave of data collection in 2007 and the effects of age on intraindividual changes in affective experiences across the five yearly waves of the study. We expected that the cross-sectional age effects will mirror the respective longitudinal effects.

Method

Participants

The data were provided by the German Socio-Economic Panel Study (SOEP; Version 28) of the German Institute for Economic Research. The SOEP is an ongoing, nationally representative longitudinal study of private households in Germany initiated in 1984 (comprehensive information about the design, participants, variables, and assessment procedures is reported in Wagner, Frick, & Schupp, 2007). All members of the selected households aged 18 years and older were asked to participate in yearly interviews. Households were initially chosen using a multistage random sampling technique with regional clustering; later some refreshment samples were taken to increase the sample size and to maintain the representativeness of the data for the entire population of Germany. In addition, new household members (e.g., new partners or grown-up children) were invited in the study

and interviewed in the yearly assessment sessions as well. To minimize attrition, individuals were followed even in cases of relocation or a split in the household. All data have been collected by a professional high-quality fieldwork organization (Infratest Social Research, Munich). Participants were compensated with a monthly nationwide lottery ticket as an unconditional incentive and a small gift after the interview. Overall, initial response rates (between 60% and 70%) were relatively high and longitudinal attrition (about 15% for the second wave and less than 5% yearly attrition across various subsamples) was low.

For the present study, we made use of the affect measures that were first gathered in 2007 and subsequently administered yearly. In 2007, a total of 20.850 participants (52.4% female) completed these measures. At this first wave, the sample was comprised of individuals aged between 18 and 98 years ($M_{\text{age}} = 49.0$ years; $SD = 17.5$ years).

The sample size at the first wave decreased across eight age groups that we composed for presentational purposes (18-27 years, $n = 2.914$; 28-37 years, $n = 2.921$; 38-47 years, $n = 4.278$; 48-57 years, $n = 3.806$; 58-67 years, $n = 3.324$; 68-77 years, $n = 2.522$; 78-87 years, $n = 975$; 88-98 years, $n = 110$). Given that inclusion of the relatively small number of individuals between 88 and 98 years in our modeling of the data of the entire sample appeared to bias our estimates and statistical tests, we decided to omit this oldest age group from our main analyses (see also Lucas & Donnellan, 2011; Specht, Egloff, & Schmukle, 2011).

Our final sample at the first wave was thus comprised of individuals aged between 18 and 87 years ($M_{\text{age}} = 48.8$ years; $SD = 17.3$ years). It included participants with different educational backgrounds (33.4% of the participants had graduated from the vocational track of the three-tier German secondary system, 35.1% had graduated from the intermediate track, and 21.6% had graduated from the academic track. The remaining 9.9% held any other type of qualification), diverse work statuses (41.0% full time, 16.1% part time, 42.9% not working), and different marital statuses (23.8% single, 60.2% married, 9.7% separated or divorced, 6.3% widowed).

Table 1 provides information about the sample's characteristics at the five waves. As can be seen, for each wave, the number of drop-outs from the initial sample at 2007 was relatively small. In comparison with the participants who provided valid data for all five waves ($n = 13,730$), the non-continuers (i.e., participants who did not provide valid data for the five waves but permanently dropped-out at one of the follow-up waves; $n = 6,383$) were younger ($M = 47.5$ years vs. $M = 49.6$ years, $p < .001$), slightly less likely to be female (51.0% vs. 52.9%, $p < .01$), slightly less educated (34.8% vs. 33.2% vocational, $p < .05$, 32.0% vs. 36.5% intermediate track, $p < .001$, 20.1% vs. 22.1% academic track, $p < .001$, 13.2% vs. 8.2% any other type of qualification, $p < .001$), less likely to be married (54.7% vs. 63.0%, $p < .001$), more likely to be single (29.6% vs. 20.7%, $p < .001$), and less likely to be separated or divorced (8.8% vs. 10.1%, $p < .01$). Furthermore, non-continuers were more likely to be unemployed (46.0% vs. 41.7%, $p < .001$) and less likely to be part-time (14.5% vs. 16.9%, $p < .001$) or full-time working (39.6% vs. 41.5%, $p < .01$). In terms of the central constructs, the non-continuers were comparably high on anger ($M = 2.90$ vs. $M = 2.89$, $p = .651$), slightly higher on sadness ($M = 2.44$ vs. $M = 2.36$, $p < .001$), but lower on happiness ($M = 2.43$ vs. $M = 2.50$, $p < .001$). Notably, these differences were significant but small. In the present analyses, participants who completed the affect measure at least at one wave were included.¹

Measures

Affective experience. Sadness, anger, and happiness were assessed via single items ("how often have you felt *anger* [*sadness*; *happiness*] during the last four weeks?"). Responses were made on a five-point scale ranging from 1 (rarely) to 5 (very often).

Statistical Models

Household panel studies, such as the SOEP, ask all members of chosen households to participate, which may result in dependencies in the data, affecting standard errors, significance levels, and goodness-of-fit tests. Therefore, we used a statistical approach that

corrects for this dependence and takes into account the complex sample structure by using household number as a cluster variable (B.O. Muthén & Satorra, 1995).²

The models were specified and tested via Mplus Version 6.12 (L.K. Muthén & Muthén, 1998-2011). To test our predictions, we specified a latent growth model for each of three emotions (i.e., anger, sadness, and happiness; see Figure 1). Each emotion was measured with one item at each measurement occasion and the error variances of the items were constrained to be equal across time points. The model included a latent intercept factor (i) and a latent slope factor (s). The latent intercept factor reflected individual differences at the first wave of measurement and was fixed to one at each measurement point. The latent slope factor reflected the amount of mean-level change and was fixed to zero in the first year, to one in the second year, to two in the third year, to three in the fourth year, and to four in the fifth year.

In our model (see Figure 1), to analyze the effects of age on mean levels in affective experiences (intercept) and on mean-level changes in affective experiences (slope), age was specified as a covariate. Because of the large sample size, we had sufficient power to also analyze nonlinear effects of age and, thus, included the quadratic (age^2) and cubic (age^3) effects of age as additional covariates (age was always mean-centered before a higher order term was calculated). In addition, the effects of gender were specified and investigated in an explorative manner (gender was coded so that 0 = men and 1 = women). Given that our model estimated longitudinal changes over time and given that the frequencies of all emotions were assessed by the same metric, the affect ratings were not standardized.

Evaluation of model fit was based on the full information maximum-likelihood estimator that allows for missing data. Given that the chi-square model test statistic is problematic (its significance heavily depends on sample size), additional measures of model fit were used, that is, comparative fit index (CFI; should be above .95), root-mean-square error of approximation (RMSEA; should not exceed .05), and standardized root-mean-square residual (SRMR; should not exceed .08).

In addition, to test the nonlinear effects of age on the intercept and slope, we compared the fit of a model that included the linear, quadratic, and cubic effects of age on the intercept or slope with the fit of a model in which these effects were fixed to zero. As these models were nested, we computed the scaled difference chi-square statistic from the scaled goodness-of-fit test statistics of the two nested models (Satorra & Bentler, 1999; given that the sample's structure with participants nested in households was complex, the chi-square statistics were scaled).

Results

The Effects of Age on Affective Experience

The effects of age and gender on the mean level (intercept) at the first wave and the mean-level change (slope) over four years, as measured in our latent growth models, can be seen in Table 2. The fit between the data and each of the three models was satisfactory.

Cross-sectional analyses: the effects of age on mean-levels in affective experience.

As seen in Table 2, all three chi-square difference tests testing the cross-sectional effects of age on anger, sadness, and happiness became significant. The significant chi-square difference tests indicate that the models that included the linear, quadratic, and cubic effects of age on the intercepts provided a better fit with the actual data than the models in which these effects were fixed to zero. This underscores that the mean levels in anger, sadness, and happiness did indeed vary by age.

More specifically, the effects of age on anger were best described by a cubic function, which is depicted in Figure 2A. Consistent with our prediction, during most of the adult life-span, age was negatively associated with anger; this association was particularly strong during the fifth and sixth decade of life. It is also evident, however, that, during young adulthood, age was positively associated with anger, suggesting an age-related increase in anger until the early thirties. Although the cubic effects of age on sadness also became significant, age effects were minor during most of adulthood and only began to increase in the sixth decade of

life (see Figure 2D). As to happiness, the effect of age was best described by a quadratic function. As seen in Figure 2G, the effect of age on happiness was negative during the entire adult-life span, but it may be somewhat less strong in old age.

Longitudinal analyses: the effects of age on mean-level changes in affective experience. As seen in Table 2, the chi-square difference tests testing the effects of age on mean-level changes in anger, sadness, and happiness over time became highly significant for anger and happiness, whereas the chi-square difference test for sadness only approached significance. The significant chi-square difference tests for anger and sadness indicate that the models that included the linear, quadratic, and cubic effects of age on the slopes provided a better fit with the actual data than the models in which these effects were fixed to zero. This underscores that age did indeed predict mean-level changes over time, particularly in anger and happiness.

More specifically, as to anger, the effects of age on mean-level changes were best described by a quadratic function. As seen in Figure 2B, in the second decade of life, mean-levels in anger increased over time, however during most of the adult-life span, beginning in the early thirties, anger significantly decreased over the four years of the study. This decrease became stronger with age until the fifth decade of life and attenuated again during the sixth, seventh, and eight decades of life. In Figure 2C, these longitudinal changes over four years are included as arrows into the cross-sectional age curve. As can be seen, the longitudinal findings are largely consistent with the cross-sectional evidence. Cross-sectionally, in young adulthood, age was positively associated with anger; this corresponds to the longitudinal increase in anger until the early thirties. The cross-sectional age effects on anger later in the adult life-span were negative, again corresponding to the longitudinal decrease in anger. The cross-sectional and longitudinal evidence even corresponded in that they both suggest that the decrease in anger is strongest during late middle adulthood. As to sadness, cross-sectional and longitudinal findings were again largely consistent. As seen in Figure 2E, consistent with the

cross-sectional findings, sadness begins to increase over time in old age (see also Figure 2F). The cubic effects of age on happiness became significant, suggesting a somewhat more complex pattern of change than the cross-sectional analyses. As seen in Figures 2H and 2I, mean-levels in happiness slightly decreased in young adulthood, remained stable during middle adulthood, and showed a more substantial decrease in old age.

Taken together, our predictions regarding the effects age on anger, sadness, and happiness were partly confirmed. Anger was highest in the second and third decades of life and significantly decreased during subsequent decades. Unexpectedly, within young adulthood, anger increased. Sadness remained stable during most of the adult life-span and only began to increase in old age. In addition, happiness decreased across the age groups, but showed more substantial longitudinal decline only in old age.

Additional findings. Consistent with past work, happiness was reported more frequently ($M = 3.46$, $SD = 0.77$) than anger ($M = 3.00$, $SD = 0.85$) and sadness ($M = 2.34$, $SD = 0.86$); the difference between anger and sadness also became significant (all t s > 78.78 ; all p s $< .001$; the analyses were based on individual means across measurements). Although gender did not predict mean-levels changes in any of the three emotions, the effects of gender on mean levels in anger and sadness became significant, suggesting that women experienced both emotions more frequently than men (see Table 2). It is also noticeable that the gender effects were significantly stronger for sadness than for anger (as indicated by a significant interaction between gender and emotion in a two-way ANOVA, $F(1, 30517) = 1001.56$, $p < .001$). The effects of gender on happiness were significant neither cross-sectionally nor longitudinally.

Discussion

Many past studies interested in age and affect frequency have adopted a dimensional approach and investigated broad affective dimensions, that is, positive and negative affect (e.g., Carstensen et al., 2011; Diener & Suh, 1997). In this study, we analyzed age differences

in the frequency of discrete emotions by utilizing cross-sectional and longitudinal data from a large adult life-span sample. More specifically, the findings are based on a data set from over 20,000 adults who reported their affective experiences at five yearly data collections. The sampling was highly sophisticated and yielded a heterogeneous sample of adults from different regions in Germany and with diverse educational, occupational, and economic backgrounds. A pattern of age differences emerged that was largely consistent across the cross-sectional and longitudinal data.

Age Differences in Anger and Sadness

The primary theoretical basis for our predictions regarding the multidirectional effects of age on anger and sadness were prominent life-span developmental theories according to which each stage in the life cycle is typified by a specific configuration of environmental challenges and opportunities as well as personal needs, beliefs, and future expectations (e.g., Baltes & Baltes, 1990; Carstensen, 2006; Heckhausen et al., 2010) that make the experience of certain emotions more likely than the experience of other emotions. More specifically, because young adulthood is a phase of growth, during which individuals pursue many goals, the elicitor of anger, that is, the appraisal that one's goals are ignored or blocked by others, should be particularly frequent and salient. In addition, anger has been thought to be associated with control appraisals (high situational control), action tendencies (persistence), and social motivations (dominance) that match younger adults' general disposition to perceive high personal control, pursue goals tenaciously, and deal with social conflicts rather than avoid them. Therefore, we predicted that younger adults would experience anger more often than their older counterparts. In this study, there even was evidence for an age-related increase in anger during young adulthood, and it was only during the third decade of life when the effects of age on anger turned negative. As expected, the decrease in anger across the age groups was visible until old age.

By contrast, old age has been described as a phase of loss. Given that older adults increasingly are confronted with fundamental losses, the elicitor of sadness, that is, the appraisal that a loss is irreversible, should be particularly salient (easily elicited). In addition, sadness has been thought to be associated with control appraisals (low situational control), action tendencies (goal disengagement), and social motivations (search for sympathy and social support) that match older adults' general disposition to perceive low personal control, flexibly adjust individual goals, and avoid social conflict for the sake of social harmony (e.g., Baltes & Baltes, 1990; Brandtstädter & Greve, 1994; Carstensen et al., 1999; Heckhausen et al., 2010). Therefore, we predicted that older adults would experience sadness more often than their younger counterparts. The findings were consistent with this prediction: older adults experienced sadness more often than young adults. Notably, however, the effects of age on sadness were not linear and suggest that sadness remains stable over most of the adult-life span and only increases in old age. Proceeding from the idea that the theme of loss becomes gradually and increasingly salient during the adult life-span, we had expected that sadness would steadily increase as well. The present findings are more consistent with a threshold model, however, suggesting that it is only in old age, during which losses in multiple domains become increasingly prevalent that sadness begins to normatively increase.

Age Differences in Happiness

A secondary goal of this study was to investigate the effects of age on happiness. Happiness is often elicited by events construed as accomplishments or progress toward one's goals (Izard, 1977; Lazarus, 1991). Given that prominent life-span developmental models have suggested that disengagement from once valued goals becomes more frequent as individuals age and their resources become increasingly limited (e.g., Brandtstädter & Greve, 1994; Heckhausen et al., 2010), we had predicted a negative association between age and happiness. Our cross-sectional findings were consistent with this prediction in that the effects of age on happiness were negative across all age groups. According to the longitudinal data, however, the decrease in

happiness over the four-years of this study was minimal in young adulthood and ceased in middle adulthood. A more substantial longitudinal decrease in mean levels of happiness was only evident in old age.

The discrepancy between the present longitudinal and cross-sectional evidence for the effects of age on happiness during adulthood certainly deserves special note. It is conceivable that the four years of this study was too short a time to detect a more substantial decrease in happiness during young and middle adulthood. However, the steady decrease in happiness across all age groups may reflect differences among cohorts. For example, younger cohorts born in the 1980s may be more willing to report their happiness or may in fact be happier than older cohorts born in the 1950s and 1940s. Longer re-test intervals of several decades are certainly required to disentangle the effects of age and cohort and to more strictly test the idea that differences in affective experiences among age groups mirror within-person changes in affective experiences over time. Notably, however, the present pattern of longitudinal stability and change in happiness, remaining stable during most of adulthood and then decreasing in old age, is consistent with the findings of two longitudinal studies with longer re-test intervals that were also based on relatively large samples covering the adult life-span and that investigated positive affect (Carstensen et al., 2011; Charles et al., 2001). Therefore, we consider it possible that the present cross-sectional effects of age on happiness during adulthood reflect cohort effects, at least partly.

The Quality of Affective Experience during Old Age

The cross-sectional and longitudinal findings regarding the effects of age on anger, sadness, and happiness during old age were remarkably consistent. Particularly, the decrease in happiness and the increase in sadness suggest that old and very old age may pose a serious challenge to the individuals' resilience and capacity to adjust to the increasing number of losses during this stage of the life-cycle. It also deserves note that, albeit significant throughout the entire life-span, the decrease in anger was at a slower rate during old age than during adulthood.

Before more firm conclusions about the overall quality of affective experiences during old age can be drawn, however, future work is needed that investigates age differences in a larger number of specific positive and negative emotions. As we have stressed throughout this article, negative affect is a multidimensional construct with multiple negative emotions, some may increase, others may remain stable, and yet others may decrease. Similarly, happiness is only one facet of the broader and multidimensional construct positive affect. Thus, although happiness may decrease in old age, other positive emotions may remain stable or increase. For example, a recent study conducted by Scheibe, English, Tsai, and Carstensen (2012) suggests that whereas positive emotions characterized by high arousal (i.e., excited, proud) decline with age, positive emotions characterized by the absence of arousal (i.e., calm, relaxed) remain stable (for similar evidence see Kessler & Staudinger, 2009).

Caveats and Outlook

The role of arousal. According to discrete emotion theories, emotions differ in terms of their elicitors, appraisals, action tendencies, and social signals (e.g., Levenson, 2000). Seen from a dimensional emotion perspective, arousal is an additional factor to be considered. For example, according to the circumplex model of emotion (e.g., Tellegen et al., 1999), anger is associated with high arousal, whereas sadness is considered a negative emotion with only moderate levels of arousal. Given that several past studies have suggested that, relative to young adults, older adults find negative high arousing emotions more unpleasant and positive high arousal emotions less pleasant (e.g., Keil & Freund, 2009; Streubel & Kunzmann, 2011), it is possible that the negative age differences in anger are the result of an age-related shift in the preference away from high arousal emotions. Notably, however, according to dimensional approaches to emotion (e.g., Tellegen et al., 1999), happiness and sadness do not differ in terms of arousal. These two emotions have been conceptualized as the opposite ends of the Pleasantness-Unpleasantness dimension which is characterized by emotions with moderate levels arousal. If it were only arousal that moderated the effects of age on affective

experiences, happiness and sadness should show similar age-trajectories. However, this was not the case: in old age sadness increased and happiness decreased as did anger. Therefore, we consider it unlikely that the present pattern of age differences in anger and sadness can be explained by arousal-differences among these two negative emotions.

Given the lack of studies that would allow the simultaneous investigation of arousal and emotion quality as moderators of age differences in affective experiences, an important task for future work is to test the relative contribution of these two moderators by studying age differences in the frequency of a wider range of negative and positive emotions than was possible in this and other relevant studies (e.g., Scheibe et al., 2012). From the perspective of our theoretical framework, it will be particularly interesting to see if one can identify specific emotions with high arousal and high age-relevance that actually increase with age.

The mechanisms behind age differences and longitudinal changes. One limitation of this study is that we could not investigate the mechanisms behind the age differences and intraindividual changes in anger, sadness, and happiness. Our predictions were grounded in the prior theoretical and empirical literatures suggesting that younger and older adults face different environmental challenges and opportunities and have different personal needs, beliefs, and future expectations (e.g., Baltes & Baltes, 1990; Brandtstädter & Greve, 1994; Carstensen et al., 1999; Heckhausen et al., 2010), but we did not include a direct assessment of these factors and, thus, could not test them as mediators of age differences and longitudinal changes in affective experiences.

Limitations of global self-reports. Because this study was based on global self-reports by respondents, a number of questions can be raised about them. For one thing, people of different age groups might have different perceptions of the socially desirable response; and there is some indication that the tendency to respond socially desirable increases with age (Stöber, 2001). It is also possible that such global reports elicit older participants' implicit theories about their own maturation. For example, if older people believe that it is

inappropriate for them to experience anger, they are likely to say that they generally experience little anger. One avenue for future research is to study age differences in discrete emotional states in the context of methods that minimize the effects of such biases, for example, by assessing specific affective experiences on a moment-to-moment basis in experience sampling studies or by utilizing the Day Reconstruction Method that instructs participants to reconstruct their previous day and thereby elicits specific and recent affective memories (e.g., Kahnemann, Krueger, Schkade, Schwarz, & Stone, 2004).

Using methods such as experience sampling or day reconstruction would have two additional advantages. A first is that they allow the simultaneous assessment of affect frequency and intensity. A second and related advantage is that one could determine the situations during which younger and older adults experience specific emotions and test to what extent age differences in emotions such as anger or sadness result from age differences in the prevalence of situations that elicit these emotions (e.g., relative to younger adults, older adults experience more losses) or from age differences in how one and the same event will be appraised (e.g., relative to younger adults, older adults may be more likely to construe a given complex and ambiguous event as a loss).

The longitudinal design. As already mentioned, one short-coming of this study is the relatively short re-test interval of four years. Given the lack of longitudinal data, we consider it an important advance to have had five waves of data collection available for our analyses. However, the present longitudinal study covering a time window of four years was considerably more restricted than the age range of the sample covering most of the adult life-span. It certainly would be desirable to study age-related changes in affective experiences within longer re-test intervals of several decades to be able to disentangle the effects of age and cohort.

Conclusions

The findings from this study clearly speak against proposals of uniform and linear age-related improvement in the quality of affective experiences across the entire adult life-span. According to our evidence, it is only anger that decreases from middle adulthood until old age; sadness remains stable during most of adulthood and then increases in old age. In addition, age differences in sadness and happiness during old age are mirror-like, that is, happiness decreases in old age. This pattern of findings is consistent with the idea that age differences in affective experiences are dependent on the discrete emotion that is being considered. It also suggests that old age is a period in life during which the overall quality of affective experiences may significantly deteriorate.

References

- Andrews, P. W., & Thomson, J.A., Jr. (2009). The bright side of being blue: Depression as an adaptation for analyzing complex problems. *Psychological Review*, 116, 620-654.
- Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 1-34). New York: Cambridge University Press.
- Baltes, P. B., & Mayer, K.U. (Eds.). (1999). *The Berlin Aging Study: Aging from 70 to 100*. New York: Cambridge University Press.
- Birditt, K. S., & Fingerman, K. L. (2005). Do we get better at picking our battles? Age differences in descriptions of behavioral reactions to interpersonal tensions. *Journal of Gerontology: Psychological Sciences*, 60B, 121-128.
- Birditt, K. S., Fingerman, K. L., & Almeida, D. M. (2005). Age differences in exposure and reactions to interpersonal tensions: A daily diary study. *Psychology and Aging*, 20, 330-340.
- Blanchard-Fields, F., Seay, R. B., & Mienaltowski, A. (2007). Age differences in everyday problem-solving effectiveness: Older adults select more effective strategies for interpersonal problems. *Journals of Gerontology: Psychological Sciences*, 62, 61-64.
- Bradburn, N. M. (1996). *The structure of psychological well-being*. Chicago: Alpine Publishing.
- Brandtstädter, J., & Greve, W. (1994). The aging self: Stabilizing and protective processes. *Developmental Review*, 14, 52-80.
- Carstensen, L. L. (2006). The Influence of a Sense of Time on Human Development. *Science*, 312, 1913-1915.

- Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, 54, 165-181.
- Carstensen, L. L., Pasupathi, M., Mayr, U., & Nesselroade, J. R. (2000). Emotional experience in everyday life across the adult life-span. *Journal of Personality and Social Psychology*, 79, 644-655.
- Carstensen, L. L., Turan, B., Scheibe, S., Ram, N., Ersner-Hershfield, H., Samanez-Larkin, G. R., Brooks, K. P., & Nesselroade, J. R. (2011). Emotional experience improves with age: Evidence based on over 10 years of experience sampling. *Psychology and Aging*, 26, 21-33.
- Charles, S. T., Carstensen, L. L., & McFall, R. M. (2001). Problem-solving in the nursing home environment: Age and experience differences in emotional reactions and responses. *Journal of Clinical Geropsychology*, 7, 319-330.
- Charles, S. T., Reynolds, C. A., & Gatz, M. (2001). Age-related differences and change in positive and negative affect over 23 years. *Personality and Social Psychology*, 80, 136-151.
- Charles, S. T., & Carstensen, L. L. (2007). Emotion regulation and aging. In J. J. Gross (Ed.), *handbook of emotion regulation* (pp. 307-327). New York: Guilford Press.
- Charles, S. T., & Carstensen, L. L. (2008). Unpleasant situations elicit different emotional responses in younger and older adults. *Psychology and Aging*, 23, 495-504.
- Diener, E., & Suh, M. E. (1997). Subjective well-being and age: An international analysis. In K. W. Schaie & M. P. Lawton (Eds.), *Annual Review of Gerontology and Geriatrics* (Vol. 8, pp. 304-324). New York: Springer.
- Ebner, N. C., Freund, A. M., & Baltes, P. B. (2006). Developmental changes in personal goal orientation from young to late adulthood: From striving for gains to maintenance and prevention of losses. *Psychology and Aging*, 21, 664-678.
- Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion*, 6, 196-200.

- Fischer, A. H., & Roseman, I. J. (2007). Beat them or ban them: the characteristics and social functions of anger and contempt. *Journal of Personality and Social Psychology*, 93, 103-115.
- Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology*, 2, 300-319.
- Frijda, N. H., Kuipers, P., & ter Schure, E. (1989). Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, 57, 212-228.
- Gross, J. J., Carstensen, L. L., Pasupathi, M., Tsai, J., Skorpen, C. G., & Hsu, A. Y. C. (1997). Emotion and aging: Experience, expression, and control. *Psychology and Aging*, 12, 590-599.
- Haase, C. M., Seider, B. H., Shiota, M. N., & Levenson, R. W. (2011). Anger and sadness in response to an emotionally neutral film: Evidence for age-specific associations with well-being. *Psychology and Aging*, 27, 305-317.
- Heckhausen, J., Wrosch, C. & Schulz, R. (2010). A motivational theory of life-span development. *Psychological Review*, 117, 32-60.
- Izard, C. (1977). *Human emotions*. New York: Plenum Press.
- Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N., & Stone, A. A. (2004). A survey method for characterizing daily life experience: The day reconstruction method. *Science*, 306, 1776-1780.
- Keil, A., & Freund, A. M. (2009). Changes in the sensitivity to appetitive and aversive arousal across adulthood. *Psychology and Aging*, 24, 668-680.
- Kessler, E.-M. & Staudinger, U. M. (2009). Affective Experience in Adulthood and Old Age: The Role of Affective Arousal and Perceived Affect Regulation. *Psychology and Aging*, 24, 349-362.

- Kunzmann, U. (2008). Differential age trajectories of positive and negative affect: Further evidence from the Berlin Aging Study. *Journals of Gerontology: PSYCHOLOGICAL SCIENCES*, 63, 261-270.
- Kunzmann, U., Smith, J., & Little, T. D. (2000). Is age-related stability of subjective well-being a paradox? Cross-sectional and longitudinal evidence from the Berlin Aging Study. *Psychology and Aging*, 15, 511-526.
- Kunzmann, U., & Grühn, D. (2005). Age differences in emotional reactivity: The sample case of sadness. *Psychology and Aging*, 20, 47-59.
- Kunzmann, U., & Richter, D. (2009). Emotional reactivity across the adult life-span: The cognitive pragmatics make a difference. *Psychology and Aging*, 24, 879-889.
- Labouvie-Vief, G., Lumley, M. A., Jain, E., & Heinze, H. (2003). Age and gender differences in cardiac reactivity and subjective emotion responses to emotional autobiographical memories. *Emotion*, 3, 115-126.
- Lachman, M. E. (2006). Perceived control over aging-related declines: Adaptive beliefs and behaviors. *Current Directions in Psychological Science*, 15, 282-286.
- Lazarus, R. S. (1991). *Emotion and adaptation*. New York: Oxford University Press.
- Lench, H. C., & Levin, L. J. (2008). Goals and responses to failure: Knowing when to hold them and when to fold them. *Motivation and Emotion*, 32, 127-140.
- Levenson, R. W. (1992). Autonomic nervous system differences among emotions. *Psychological Science*, 3, 23-27.
- Levenson, R. W. (2000). Expressive, physiological, and subjective changes in emotion across adulthood. In S. H. Qualls & N. Abeles (Eds.), *Dialogues about aging: Psychology responds to the aging revolution* (pp. 123-140). Washington, DC: American Psychological Association.
- Lindenberger, U., & Baltes, P. B. (1997). Intellectual functioning in old and very old age: First results from the Berlin Aging Study. *Psychology & Aging*, 12, 410-432.

- Lucas, R. E., & Donnellan, M. B. (2011). Personality development across the life-span: Longitudinal analyses with a national sample from Germany. *Journal of Personality and Social Psychology, 101*, 847-861.
- Mroczek, D. K., & Kolarz, C. M. (1998). The effect of age on positive and negative affect: A developmental perspective on happiness. *Journal of Personality and Social Psychology, 75*, 1333-1349.
- Muthén, B. O., & Satorra, A. (1995). Complex sample data in structural equation modeling. *Sociological Methodology, 25*, 267-316.
- Muthén, L. K., & Muthén, B. O. (1998-2011). *Mplus user's guide (6th edition)*. Los Angeles, CA: Muthén & Muthén.
- Rothermund, K., & Brandtstädter, J. (2003). Coping with deficits and losses in later life: from compensatory action to accommodation. *Psychology and Aging, 18*, 896-905.
- Satorra, A., & Bentler, P. (1999). A Scaled Difference Chi-square Test Statistic for Moment Structure Analysis. *Psychometrika, 66*, 507-514.
- Scheibe, S., English, T., Tsai, J. L., & Carstensen, L. L. (2012). Striving to Feel Good: Ideal Affect, Actual Affect, and Their Correspondence Across Adulthood. *Psychology and Aging*. Advance online publication. doi: 10.1037/a0030561
- Schimmack, U, Oishi, S., Diener, E., & Suh, M. (2000). Facets of affective experiences: A new look at the relation between pleasant and unpleasant affect. *Personality and Social Psychology Bulletin, 26*, 655-668.
- Seider, B.H., Shiota, M. N., Whalen P., & Levenson R. W. (2011). Greater sadness reactivity in late life. *Social Cognitive and Affective Neuroscience, 6*, 186-194.
- Smith, J., & Baltes, P. B. (1997). Profiles of psychological functioning in the old and oldest-old. *Psychology and Aging, 12*, 458-472.

- Specht, J., Egloff, B., & Schmukle, S. C. (2011). Stability and change of personality across the life course: The impact of age and major life events on mean-level and rank-order stability of the Big Five. *Journal of Personality and Social Psychology, 101*, 862-882.
- Stacey, C. A., & Gatz, M. (1991). Cross-sectional age differences and longitudinal change on the Bradburn Affect Balance Scale. *Journals of Gerontology, 46*, 76-78.
- Stöber, J. (2001). The Social Desirability Scale-17 (SDS-17): Convergent validity, discriminant validity, and relationship with age. *European Journal of Psychological Assessment, 17*, 222-232.
- Streubel, B., & Kunzmann, U. (2011). Age differences in emotional reactions: Arousal and age-relevance count. *Psychology and Aging, 26*, 966-978.
- Tellegen, A., Watson, D., & Clark, L. A. (1999). On the dimensional and hierarchical structure of affect. *Psychological Science, 10*, 297-303.
- Tsai, J. L., Levenson, R. W., & Carstensen, L. L. (2001). Autonomic, subjective, and expressive responses to emotional films in older and younger Chinese Americans and European Americans. *Psychology and Aging, 15*, 684-693.
- Wagner, G. G., Frick, J. R., & Schupp, J. (2007). Enhancing the power of household panel studies: The case of the German Socio-Economic Panel Study (SOEP). *Schmollers Jahrbuch, 127*, 139-169.
- Wrosch, C., & Heckhausen, J. (1999). Control processes before and after passing a developmental deadline: Activation and deactivation of intimate relationship goals. *Journal of Personality and Social Psychology, 77*, 415-427.

Footnotes

¹ Analyses of only those individuals who provided data from all five waves revealed largely the same findings as the analyses of the full sample (see Table 2); that is, a highly similar pattern of age effects on individual differences and intraindividual changes in anger, sadness, and happiness was found.

² Intraclass correlations suggest that considerable and statistically significant amounts of variance were indeed attributable to households (*anger*: .20, *sadness*: .16, *happiness*: .25; all $ps < .001$), besides individual (*anger*: .56, *sadness*: .57, *happiness*: .50; all $ps < .001$) and time-based differences (*anger*: .24, *sadness*: .28, *happiness*: .25; all $ps < .001$).

Table 1. *Sample Composition and Characteristics of the Full Sample at Five Waves.*

Sample	Five Waves of the Longitudinal Study				
	2007	2008	2009	2010	2011
Composition					
Primary sample	20.740	18.666	17.106	15.518	14.357
Total sample	20.740	19.561	20.678	18.828	20.959
Full Sample Characteristics					
Age	48.8 (17.3)	48.3 (17.5)	47.8 (17.6)	47.5 (17.6)	47.2 (17.7)
Gender	52.3	52.3	52.3	52.4	52.8

Note. For more information about the full sample's characteristics in terms of education, work, marriage, and the main variables of the study see text. In contrast to the primary sample, the total sample included new household members as well as refreshment subsamples. Age refers to mean levels, standard deviations are provided in brackets. Gender information refers to the percent of women.

Table 2. *Model Statistics and Effects of Age and Gender on Mean-Levels (Intercepts) at Wave 1 and Mean-Level Changes (Slopes) over Time in Anger, Sadness, and Happiness*

Model statistics	Anger (<i>N</i> = 30,527)		Sadness (<i>N</i> = 30,524)		Happiness (<i>N</i> = 30,517)				
Model fit									
χ^2 (<i>df</i>)	220 (26)		185 (26)		257 (26)				
CFI	0.991		0.992		0.990				
RMSEA	0.016		0.014		0.017				
SRMR	0.018		0.017		0.027				
	<i>Par.</i>	<i>p</i>	<i>Par.</i>	<i>p</i>	<i>Par.</i>	<i>P</i>			
Intercept									
Mean	2.8658	.000	2.3623	.000	3.5033	.000			
Variance	.4902	.000	.5282	.000	.4078	.000			
Effects									
Gender	-.0460	.000	-.3876	.000	-.0158	.075			
Age	-.1440	.000	-.0178	.028	-.0958	.000			
Age ²	-.0434	.000	.0053	.015	.0090	.000			
Age ³	.0075	.000	.0023	.043	-.0005	.605			
Slope									
Mean	-.1359	.000	.0404	.000	-.0160	.025			
Variance	.2057	.000	.2442	.000	.1759	.000			
Effects									
Gender	-.0264	.063	.0110	.435	-.0111	.336			
Age	-.0373	.000	-.0102	.313	.0229	.008			
Age ²	.0185	.000	.0002	.929	-.0052	.021			
Age ³	.0003	.842	.0028	.052	-.0032	.009			
Test for age									
effects	$\Delta \chi^2(3)$	<i>p</i>	Var _{expl}	$\Delta \chi^2(3)$	<i>p</i>	Var _{expl}	$\Delta \chi^2(3)$	<i>p</i>	Var _{expl}
Intercept	1297.60	.000	.0547	15.34	.002	.0007	858.16	.000	.0309
Slope	99.31	.000	.0033	6.71	.082	.0011	16.82	.000	.0017

Notes. Values for age are given in 10-year units. Age was centered before higher order terms were calculated, gender was dummy coded (0 = female, 1 = male). Effects are unstandardized. Par. = Parameter; CFI = comparative fit index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual; Var_{expl} = explained

variance, i.e. difference in residual variances between model without age terms and model with age terms.

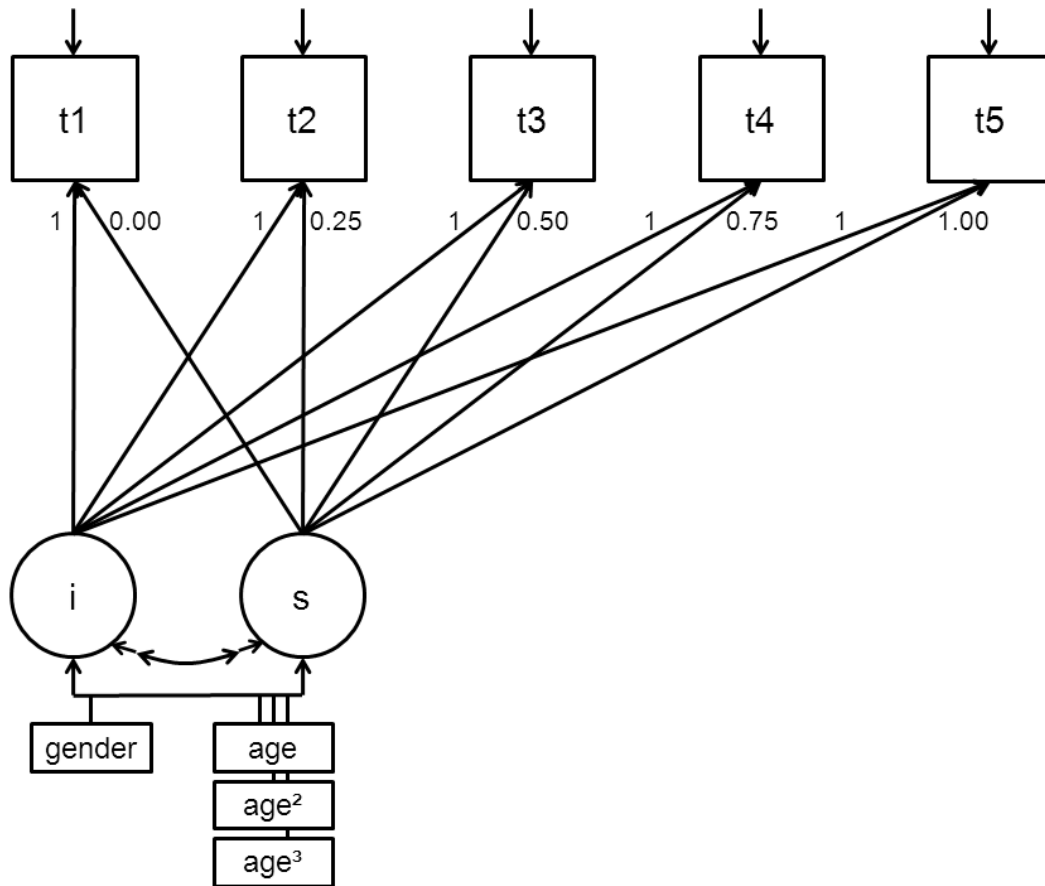


Figure 1. Analyses of the effects of age and gender on the mean level (intercept) and change (slope) for each of the three emotions using latent growth curve modeling. Each emotion was measured with one item at each measurement occasion (t1 to t5) and the error variance of the item was constrained to be equal across time points. The latent intercept (i) was fixed to 1 on t1, t2, t3, t4, and t5 and refers to the estimated mean frequency of affect at t1. The latent slope was fixed to 0.00 on t1, to 0.25 on t2, to 0.50 on t3, to 0.75 on t4, and to 1.00 on t5 and refers to the estimated mean difference between two neighboring measurement occasions. Gender, age, age², and age³ were included as predictors of i and s (for results, see Table 2).

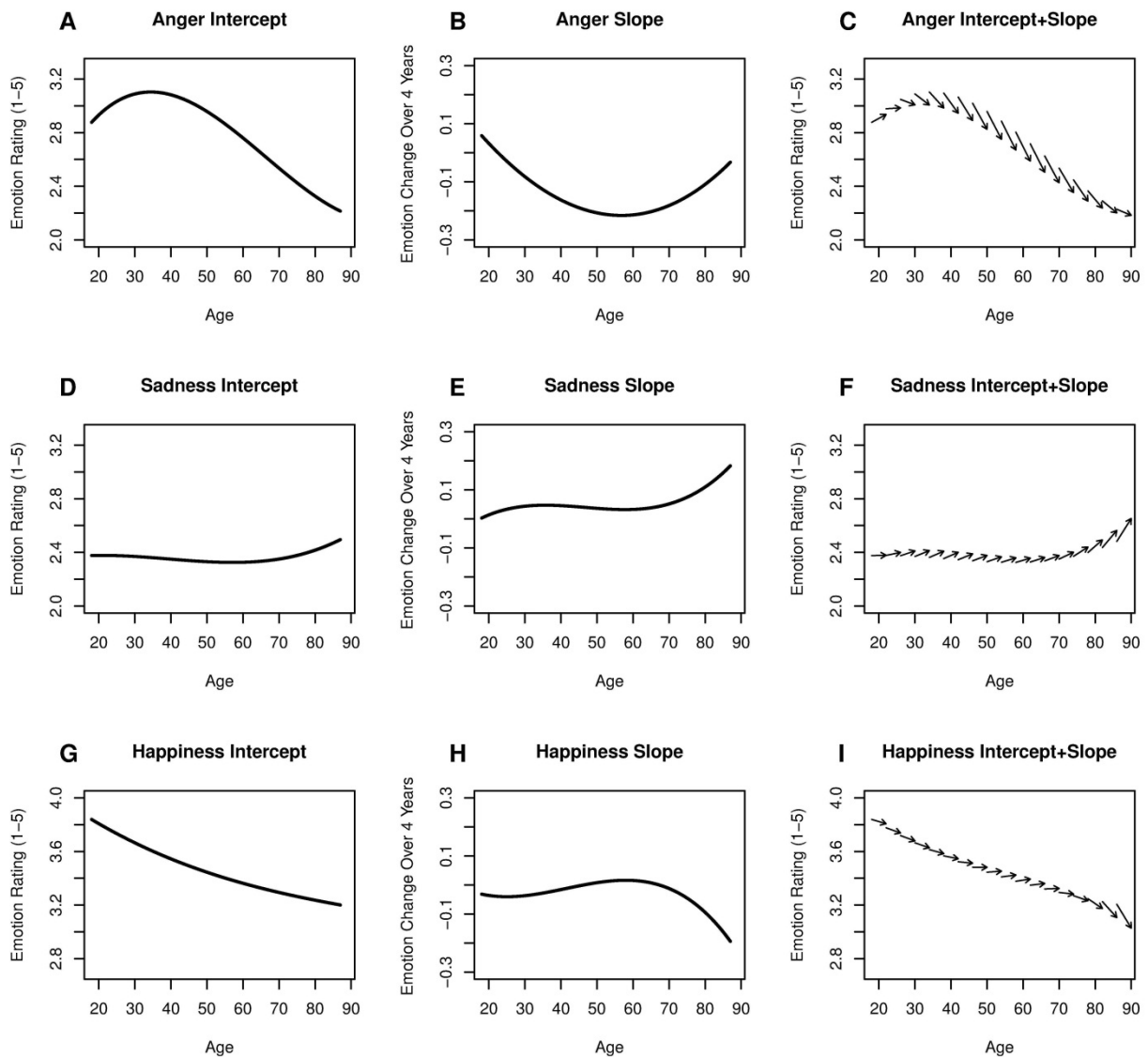


Figure 2. Anger, sadness, and happiness: age differences in mean levels (intercepts) at the first wave (A, D, G) and age differences in mean level changes (slopes) over time (B, E, H). The effects are statistically controlled for gender. Positive slope values indicate mean-level increases from 2007 to 2011, whereas negative slope values indicate mean-level decreases across the four years under study (see Figure 1 for further information on the underlying model and Table 2 for the exact values underlying the graphs). A combined display of age differences in intercepts and slopes is presented in Panels C, F, I. Here, both the mean levels and the mean level changes over the four years are plotted for 18 different ages (ranging from 18 to 86).