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Affective experience across the adult lifespan: An accelerated longitudinal design

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Abstract

Recent research investigating the course of affective development across the adult lifespan has incorporated both cross-sectional and longitudinal data in analyses to understand the aging-affect relationship. Most of these studies, however, have not provided an empirical test to determine whether the cross-sectional and longitudinal data can be combined to infer developmental processes. Utilizing an age heterogeneous sample followed over a 10-year span (N= 1019, Mage=54.14 ± 13.06), the present study used an accelerated longitudinal design to investigate whether cross-sectional age differences could be found in longitudinal aging trajectories of positive affect (PA), negative affect (NA), and their confluence (i.e., *affect optimization*, the experience of PA relative to NA). Additionally, age-related differences in *poignancy*, co-occurrences of PA and NA, were examined. Absence of cross-sectional age-differences in the estimated longitudinal aging trajectories of PA and affect optimization suggested that a developmental process could be inferred; whereas, the longitudinal aging trajectories for NA showed cross-sectional age differences. PA and affect optimization showed a cubic relationship with age; NA showed decreases across adulthood; and poignancy showed age-related increases across adulthood. Self-rated health was investigated as a covariate in all models. Though somewhat more nuanced, the estimated trajectories for PA, NA, affect optimization, and poignancy provided support for theories of affective aging. The implications of these findings, directions for future research, and issues surrounding using cross-sectional data to infer developmental change are discussed.

Keywords

Positive Affect; Negative Affect; Lifespan Development; Accelerated Longitudinal Design

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One indicator of how individuals navigate the "slings and arrows" of life is the course of affect across the lifespan. Not only does affect play an important role in how we engage with the world, but positive and negative affect are also linked to health and well-being outcomes; this appears especially true for positive affect and the ability to concurrently experience mixtures of emotions (Hershfield, Scheibe, Sims, & Carstensen, 2013; Ong, 2010). Although the terms positive (PA) and negative (NA) affect seem to suggest opposing ends of the same continuum, each is a distinct dimension of affect and relates to unique clusters of variables (Watson, Clark & Tellegan, 1988). PA has been associated with social activity, satisfaction, and occurrences of pleasant events; whereas, NA has been associated with health complaints, self-reported stress, and poor coping (Clark & Watson, 1988; Beiser 1974; Watson et al., 1988). Furthermore, combinations of different levels of PA and NA provide insight into diverse constructs. Low PA and high NA is symptomatic of depression and anxiety (Watson & Tellegen, 1985) and co-occurrence of PA and NA—moderate to high levels of both PA and NA—is linked to dispositional resilience (Ong, 2010). Consequently, in the study of affective experience, much is gained in studying PA and NA independently and in unison. Studying changes in affect across the adult life course can inform understandings of the dynamics of related variables (e.g., social activity, health complaints, depression) that may be driving or, conversely, being influenced by affective experience. The first step in better understanding these relationships is to examine patterns of affective experience.

Lifespan theorists of affective development suggest that general levels of PA and NA change from young to old age (Carstensen, 1995; Charles 2010; Labouvie-Vief, 1989). Because adulthood encompasses 40-80 years, however, empirical investigations of these theoretical tenets have been difficult. Researchers have primarily used either cross-sectional or longitudinal designs (e.g., Griffon, 2004; Kessler & Staudinger, 2009; Kunzmann et al, 2000). Unfortunately, the limited information provided by such designs has led to inconsistencies in the literature—making it difficult to map trajectories of PA and NA, and their confluence, across the adult life course (Pinquart, 2001; Schaie & Baltes, 1975). More recent studies have incorporated both cross-sectional and longitudinal data in their examinations (i.e., Carstensen et al., 2011; Charles, Reynolds, & Gatz, 2001; Kunzmann, Richter, & Schmukle, 2013); unfortunately, only one empirically tested the convergence of cross-sectional and longitudinal results. The purpose of this study is to use an accelerated longitudinal design to model the developmental trajectories of affective experience. *Accelerated longitudinal designs* combine the advantages of both cross-sectional and longitudinal designs—following an age heterogeneous sample over multiple measurement occasions—while also minimizing the unique limitations of each. The result is information about developmental trends over a longer portion of the lifespan than is represented in the measurement occasions.

Theories of Affective Development

Contemporary lifespan theorists propose that affective well-being improves with age (Carstensen, 1995; Carstensen & Charles, 1998; Charles 2010; Labouvie-Vief, 1989; Labouvie-Vief, Diehl, Jain, & Zhang, 2007). Processes of maintenance and compensation, and changes in environmental challenges, personal beliefs, motivations, and future expectations as one ages and reaches different stages of adulthood make the experience of certain affective states more probable others. Specifically, these theorists suggest that life salient tasks in young adulthood are more likely to elicit negative affective states; whereas, experiences in later adulthood are thought to promote more positive affect states.

Carstensen's Socioemotional Selectivity Theory (SST; Carstensen, 1992, 1995; Carstensen & Charles, 1998) posits that affective well-being improves with age due to changing motivations related to age-salient tasks. Specifically, two motives guide affective experience throughout adulthood, the emotion trajectory and the information trajectory, and a motivational shift from future-oriented goals in young adulthood to a focus on the present in later life underlies changes in affective experience. In young and middle adulthood, the *information trajectory*, defined as strivings for knowledge and information, drives affective experience. As a result, younger adults sacrifice affective well-being in the pursuit of knowledge. As one ages, acquires an understanding of the world, and begins to perceive his/her own future as relatively short, however, importance shifts from information seeking to emotionally satisfying goals. Thus, later in life, the *emotion regulation trajectory*, defined as maintaining a state of emotional well-being and focusing on meaningful and satisfying relationships, is prominent.

Charles's Strength and Vulnerability Integration (SAVI; Charles, 2010) builds on SST by including the role of gained experiences that come with the passage of time. Charles posits that in addition to shifting motivations and age-salient tasks, improvements in affective well-being can be attributed to developments in emotion regulation strategies. Exposure to stressors that naturally accompany the aging process help individuals learn appropriate emotion regulation strategies that they can use to either avoid or cope with negative stimuli. This, in turn, fosters affective well-being. Older adults, therefore, are not only more concerned with the present, but also better understand how to employ attentional, appraisal and/or behavioral strategies to feel content and avoid negative affective experiences.

Taking a cognitive-developmental perspective, Labouvie-Vief (2007) attributes developmental changes in affective experience to a dynamic system of affective optimization and complexity. In Dynamic Integration Theory (DIT), *affect optimization* is the maximization of PA and minimization of NA in processing affect, whereas, *affect complexity* represents the coordination of feelings in the present with past and future feelings, as well as with those of others as to effectively experience positive and negative affect simultaneously. According to this theory, life experiences and developmental tasks contribute to increasing levels of affective complexity in young adulthood, which peaks in middle adulthood. In a process of selective optimization with compensation, as affect complexity diminishes across later life due to declines in cognitive functioning (Baltes & Baltes, 1990; Labouvie-Vief, et al., 2007), individuals counteract this change by boosting their ratio of PA to NA through affect optimization. In integrating positive and negative emotional experiences, through either optimization or complexity, individuals maintain a crucial dynamic balance to support their emotional well-being. Thus, in addition to individual trajectories of PA and NA, DIT speaks to the balance and co-occurrence of PA and NA across the lifespan.

Together, SST, SAVI, and DIT provide models to predict trajectories of emotional experience. The transition from information-seeking to emotional motives in adulthood and improvements in emotion regulation correspond to increases in PA and decreases in NA across the adult life course (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Carstensen, 1992; Charles, 2010; Fung, Carstensen, & Lutz, 1999). In latest adulthood, however, downturns in PA (and upturns in NA) can be found and are attributable to uncontrollable stressors that older adults cannot avoid, such as loss of social belonging and neurological dysregulation (Charles, 2010; Scheibe & Blanchard-Fields, 2009). Throughout adulthood affect optimization and affect complexity work in tandem, with decreases in complexity producing compensatory escalations in optimization, and conversely, increases in complexity resulting in reductions of optimization (Labouvie-Vief, et al., 2007; Labouvie-Vief & Medler, 2002). The general expectations are that optimization increases across adulthood and complexity increases from young adulthood into middle adulthood and declines from middle adulthood into old age.

Empirical investigations of PA and NA

Early investigations of affective experience in adulthood primarily used only cross-sectional or longitudinal designs (Griffon, 2004; Kessler & Staudinger, 2009; Kunzmann et al, 2000; Mroczek & Kolarz, 1998; Windsor, Burns, & Byle, 2012). Cross-sectional designs provide information about age differences, but confound age with cohort effects, which may not reflect a developmental course, especially across long age spans. Longitudinal designs provide information about age-related change, but the narrow time scope, attrition of subjects, and the historical context of the cohort during which the data are collected, restrict its value (Baltes, Reese, & Nesselroade, 1988; Cook, Campbell, & Day, 1979). These limitations often lead to inconsistent, and sometimes even conflicting, results. For example, multiple longitudinal studies (e.g., Charles et al., 2001; Griffin, 2004; Kunzmann et al., 2000) have either suggested a negative linear relationship between age and positive affect or no relationship at all, which contradicts the theories discussed. Cross-sectional studies, on the other hand, have suggested a positive relationship between PA and age, which supports the discussed theories (Griffin, 2004; Kessler & Staudinger, 2009; Mroczek & Kolarz, 1998; Windsor & Anstey, 2010; Windsor, et al., 2012). Thus, to better understand the developmental trajectories of PA and NA, more recent research has concurrently examined both cross-sectional and longitudinal data (Carstensen et al., 2011; Charles et al., 2001; Kunzmann et al., 2013).

Examining discrete dimensions of PA and NA (i.e., happiness, sadness, and anger), in an age heterogeneous sample (i.e., 18-98) followed for 5 years (assessed annually), Kunzmann and colleagues' (2013) results supported the notion of nonlinearity in lifespan trajectories of PA and NA. Although they found a negative association between their facet of PA (i.e., happiness) and age-related differences, the longitudinal association showed stability of happiness until approximately age 65 when significant decreases were reported. For their facets of NA, cross-sectional age differences in anger and sadness followed a cubic pattern. Anger increased until subjects' early thirties when it then began to decline with the declines stabilizing in latest adulthood (i.e. after age 80). Sadness, on the other hand, showed relatively minor age differences until roughly age 70 when it then began to increase.

Although not explicitly tested, the longitudinal results of within person change supported the same pattern of results for both anger and sadness.

Utilizing a large, age heterogeneous sample assessed four times over a 23-year span, Charles and colleagues (2001) also investigated cross-sectional and longitudinal aging-affect associations within the same sample. Similar to Kunzmann's and colleagues' (2013) longitudinal findings, both cross-sectional mean levels of PA and longitudinal change in PA were relatively stable across the differing age groups until about age 60 when declines ensued. Differing from Kunzmann's and colleagues' results, cross-sectional mean levels of NA were the largest for the youngest age group and were the smallest for the oldest age group and NA decreased across all age groups until about age 60 when decreases leveled off. Going a step further, Charles included an empirical test to compare age-related differences in affective experience to age-related changes. Although the cross-sectional results appeared to be consistent with the longitudinal associations, when parameter estimates were compared across the age groups, significant differences were found—suggesting a single developmental growth model could not be obtained for either PA or NA. Charles's study was limited, however, in that it only included four measurement occasions and more complex patterns of change were not investigated (i.e., only the results of a linear relationship between age and affect were reported). These limitations may have led to the non-convergence of their cross-section and longitudinal results.

The present study aims to build on these more recent empirical investigations by incorporating a greater number of measurement occasions (i.e., up to ten across 10 years) that will: 1) allow for the testing of more complex patterns of affective change, and 2) will provide a more precise statistical test of differences in cross-sectional aging trajectories (Zhang & Wang, 2009). In accordance with current affective aging theories and prior research, PA is hypothesized to show increases across adulthood, leveling off in mid-60s, and NA is hypothesized to show steady declines, leveling off in mid-60s. Due to a larger number of measurement occasions and thus a greater amount of temporal overlap in the cross-sectional aging trajectories compared to previous studies, parameter estimates for the cross-sectional aging trajectories for PA and NA are hypothesized to not differ statistically.

Empirical investigations of the confluence of PA and NA

Evidence for affect optimization and affect complexity also comes from a combination of cross-sectional and longitudinal data. In a longitudinal study with an age heterogeneous sample, Labouvie-Vief and colleagues (2007) found individuals who entered their study at different ages had different levels and rates of change in affect optimization over the 6-year period, with adults up to age 60 showing both higher levels of affect optimization and greater increases in affect optimization. Cross-sectional age differences in affect complexity showed increases from young adulthood into mid-life with declines in complexity starting at about age 45; however, longitudinal results suggested declines in affect complexity across all age groups. It is important to note that this study used self-narratives and the Coping and Defense scales from the CPI (Gough, 1987), rather than subjective measures of PA and NA in the operationalization of affect optimization and complexity.

In two separate, but related studies, Carstensen and colleagues (2000, 2011) took a different approach to studying affect optimization and complexity by testing changes in indices of subjective affect across the lifespan. In the first study, data was collected from an age heterogeneous sample five times a day across a one-week period. The correlation between PA and NA across the time series exemplified one aspect of affect complexity, *poignancy* (i.e., a mixture of positive and negative emotional states). Cross-sectional results indicated that older adults experienced greater poignancy as compared to their younger counterparts. Carstensen's and colleagues' sample provided two additional bursts of data across a 10-year period and these findings were expanded in a follow up study (2011). In the second study, both age-related differences and within person change in poignancy was assessed. Additionally, age-related differences and within person change in affect optimization, operationalized by subtracting mean levels of NA from mean levels of PA for each participant, were also examined. Supporting findings from the earlier cross-sectional study, the results of the longitudinal analysis suggested within person, age-related increases in poignancy. As for affect optimization, cross-sectional and longitudinal associations were congruent and suggested increases in optimization until about age 60 when increases stabilized.

Results from Labouvie-Vief's and colleagues' (2007) and Carstensen's and colleagues' (2000 (2011) studies of changes in the confluence of affective states provide conflicting evidence. Differing operationalization of this construct has led to conflicting inferences about how PA and NA co-vary across adulthood. It is also important to note that neither study provided an empirical test to determine whether the cross-sectional and longitudinal trajectories could be combined to infer developmental change. Therefore, the present study will build on these empirical investigations by: 1) using subjective measures of PA and NA to map trajectories of affect optimization and poignancy across adulthood, and 2) incorporating a statistical test to discern potential cross-sectional differences in the longitudinal aging trajectories of affect optimization. Affect optimization is hypothesized to show increases across adulthood; whereas, poignancy is expected to show increases until roughly mid-40s when it is then expected to decline into later adulthood.

The goal of the present study is to use an accelerated longitudinal design (i.e., ALD) to investigate the trajectories of PA and NA and their union across the adult lifespan. ALDs combine the advantages of both cross-sectional and longitudinal designs while also minimizing the unique limitations of each design, helping to gain information about developmental trends over a longer portion of the lifespan (Duncan, Duncan, & Hops, 1994). In an ALD, participants of different ages are measured repeatedly over a number of measurement occasions (here up to 10). By design, the multiple measurement occasions result in overlapping trajectories, with the trajectory at each age overlying the next age group's trajectory. This method allows us to segregate age-related differences from age-related change by the use of statistical modeling and significance testing. If no significant differences are found, then the age-related differences and age-related change can be said to be convergent and a single average trajectory can be used to represent the developmental trend. If there is a significant difference in the cross-sectional aging trajectories, other variables, such as self-rated health (e.g., some researches have suggested that change in affect may be influenced by "time left" rather than age per se; Fredrickson & Carstensen, 1990; Gerstorf et al., 2008), can be incorporated into the model to help explain the between person, age-related differences in age-related change (for a review *see* Miyazaki & Raudenbush, 2000). By incorporating a greater number of measurement occasions, explicitly testing for differences in cross-sectional aging trajectories, and broadening the perspective to include the joint influence of PA and NA (through assessments of affect optimization and poignancy), the present study will provide a richer depiction of affect change across the adult lifespan.

Methods

Participants

Participants for this study came from the Notre Dame Study of Health & Well-being (NDHWB; Bergeman & Deboeck, 2014). The full NDHWB sample is comprised of 1328 participants aged 19-91 (M=54.14±13.06) at the first wave of data collection; whereas, the subsample used for this study consisted of 1019 participants aged 28 to 83 at the first point of measurement (M= 55.32±11.98). There was limited information provided in the tails of the age distribution from the full sample of NDHWB, which produced unreliable parameter estimates for the youngest and oldest participants. Additionally, for inclusion in the study, participants had to provide data at a minimum of two waves. The NDHWB has 10 measurement occasions across a 10-year timespan. On average, participants in the current study provided data at approximately 5 of the measurement occasions (4.88±3.03). Data collection for this study underwent and received approval from the Notre Dame Institutional Review Board (protocol #12-07-399).

The full NDHWB sample and the subsample did not significantly differ in terms of gender, marital status, education and household income at Time 1. The majority of the full and subsample at the first point of measurement were female (61.04% and 61.35%, respectively), married (52.66% and 50.13%), and had at least some college education (62.04% and 61.96%). The majority of the participants in both samples had an annual household income between $25,000-$74,999 (53.23% and 52.57%). Based on gender, race, income, education, the sample represents the five-county region from which it is drawn. (Indiana Fact Book, 2004).

At each measurement occasion (excluding Time 9 and Time 10) new participants were recruited into the study. Additionally, participants lost at follow-up were allowed to re-enter the study at a later measurement occasions (e.g., if a participant missed a measurement occasion at Time 2, they may still have provided data at a later measurement occasion such as Time 4). The general composition of the subsample used for this study remained stable from year to year. The only notable differences in the subsample across the measurement occasions is that a significantly higher percentage of our sample was widowed or divorced at Time 7 and Time 8 as compared to Time 1 and Time 2 ($F(9,5781)=4.08$, $p<.0001$), and there were significant differences in the distribution of income from Time 1 and Time 2 to Time 6 and Time 7 such that those in the later measurement occasions were more likely to report lower household income levels, $F(9,5713)=3.84$, $p<.0001$. For complete descriptive statistics for the subsample at each time point, see Table 1.

Measures

Positive and Negative Affect—

Positive and Negative Affect were measured using the Brief Measures of Positive Affect and Negative Affect Scale (Watson et al., 1998). Participants were asked to rate on a scale from one to five the extent to which they generally felt the listed emotions (e.g., active, irritable, jittery, excited, hostile, upset). PA and NA were each comprised of 10 items. PA had a grand mean of 34.84 (grand SD=6.99); NA had a grand mean of 16.67 (grand SD=6.48). PA was approximately symmetrically distributed (skew= −0.359, kurtosis=−0.033); whereas, NA showed a positively skewed distribution (skew=1.419, kurtosis=2.268). Coefficient alpha reliability estimates for PA and NA at Time 1 are 0.86 and 0.84, respectively.

Affect Optimization—

Affect Optimization was operationalized as the difference between self-reported positive and negative affect. That is, NA ratings were subtracted from PA ratings for each individual at each measurement occasion. Affect Optimization had a grand mean of 18.16 (grand SD=11.02) and was approximately symmetrically distributed (skew= −0.82, kurtosis=0.82).

Poignancy—

Poignancy was operationalized using the Pearson correlation between PA and NA computed at each age across all of measurement occasions (i.e., a person aged 60 at Time 1 and another person aged 60 at time 5, for example, equally contributed to the correlation between PA and NA at age 60). Our operationalization of poignancy differs somewhat from previous investigation in that correlations for a single individual at each age could not be obtained because only one point of measure was available for each individual at a particular age. Consequently, poignancy is comprised of both between and within person information.

Self-rated Health—

Self-rated Health was measured at Time 1 using an adapted version of the Measurement of Physical Health survey (Belloc, Breslow, & Hochstim, 1971). This measure is intended to categorize individuals' health along a continuum from a low state of functioning characterized by low levels of energy and reports of general poor health to an optimal state of functioning characterized by no health complaints and a high level of energy. Because items had different response formats, all items were standardized prior to summing. Scores range from −9 to 12, higher scores indicating poorer health. Self-rated health had a grand mean of −.07 (Grand SD=4.45) and was approximately symmetrically distributed (skew=0.51 and kurtosis= −0.32). The coefficient alpha reliability estimates for self-rated health at Time 1 was .84.

Analytic Technique

Our investigation of PA and NA followed a three-step analytic procedure. First, we specified an appropriate change function individually for PA and NA. Due to inconsistencies in the literature, no-change, linear, quadratic, and cubic functions were employed. In addition, multiple piecewise functions representing a change in the linear rates of change in PA and NA were also used. Based on the literature, potential change points in the linear rates of change were investigated every five years from ages 45-70, and using the profile likelihood method, the best fitting piecewise model was selected (McArdle & Wang, 2008). The best fitting growth model was chosen by conducting likelihood ratio tests for nested models and comparing the Bayesian Information Criteria and Akaike Information Criteria values for models that were not nested. Because the age range in the present study spans from 28 to 83, the zero point for age was rescaled at 28 to provide a meaningful intercept. Similarly, because the study spans over 50 years, decades were chosen as the time metric to avoid computational issues for more complex models. The Level-1 linear model for positive affect is represented by the following equation,

$$PA_{ij} = \left[b_{0i} + b_{1i}\left(\left(Age_{ij} - 28\right)/10\right)\right] + \left[\varepsilon_{ij}\right], \quad (1)$$

in which b_{0i} represents the level of PA at age 28 (the intercept) for individual i, b_{1i} represents the linear rate of change in PA for individual i per decade, and ε_{ij} represents the residual around the fitted trajectory for individual i at time j. For the quadratic model, the Level-1 equation is

$$PA_{ij} = \left[b_{0i} + b_{1i}\left(\left(Age_{ij} - 28\right)/10\right) + b_{2i}\left(\left(Age_{ij} - 28\right)/10\right)^2\right] + \left[\varepsilon_{ij}\right], \quad (2)$$

in which b_{1i} represents the instantaneous linear rate of change at age 28 and b_{2i} represents the acceleration in the decennial rates of change for individual i. The cubic function takes the following form,

$$PA_{ij} = \left[b_{0i} + b_{1i}\left(\left(Age_{ij} - 28\right)/10\right) + b_{2i}\left(\left(Age_{ij} - 28\right)/10\right)^2 + b_{3i}\left(\left(Age_{ij} - 28\right)/10\right)^3\right] + \left[\varepsilon_{ij}\right],$$

(3)

This more complex form of change signifies two turning points in which the trajectory changes from either an increasing trend to a decreasing trend and then back to an increasing trend or vice versa. Thus, both a trough and a peak can be identified.

In the piecewise models, we have

$$PA_{ij} = \left[\pi_{0i} + \pi_{1i}\left(\left(Age_{ij} - 28\right)/10\right) + \pi_{2i}\left(dum_j * \left(Age_{ij} - changepoint\right)/10\right)\right] + \left[\varepsilon_{ij}\right], \quad (4)$$

in which π_{1i} represents the linear rate of change before the change point (i.e., age 45, 50, 55, 60, 65, or 70), π_{2i} represents an immediate shift in the rate of change for individual i at the specified age, and dum_j is an indicator variable with values of 0 when the age value at time j is smaller or equal to the change point and values of 1 otherwise. The same set of growth curve equations were used to examine the relationships between age and NA.

Once an appropriate change function was specified, the second step in this analytic procedure was to test for cross-sectional age differences in the longitudinal aging trajectories. Age at Time 1 along with the appropriate interaction terms were added at Level-2 to account for between person differences in the change parameters. Thus, person-specific change parameters in this model (i.e., the full model) depend on age at Time 1. Estimates were obtained for the full and the reduced (i.e., without age at Time 1 as a Level-2 predictor) models, and the fit of the two models were compared using a likelihood ratio test (see Miyazaki & Raudenbush, 2000 for a detailed explanation). A significant chi-squared statistic suggests significant cross-sectional age differences in the longitudinal aging trajectories. Because the chi-squared statistic is often too liberal (i.e., simpler models tend to be over-rejected), especially with large sample sizes, Wald tests were also used (Curran, Bauer, & Willoughby, 2006; Yuan & Bentler, 1998). The presence of a significant effect of age at Time 1 on any of the individual change parameters supported a significant chi-squared difference test and indicated which parameter(s) in the longitudinal aging trajectories showed cross-sectional age differences.

The third step in this procedure was to add self-rated health as a covariate in the reduced models and, if applicable, full models. If cross-sectional age differences were found in the longitudinal aging trajectory in Step 2, the fit of the reduced model compared to the full model was then reassessed with the incorporation of self-rated health (see Miyazaki & Raudenbush, 2000). Although the primary rational for incorporating self-rated health into the reduced and full models was to explain cross-sectional differences in the longitudinal aging trajectories of PA and NA, self-rated health was also incorporated into reduced models in the absence of cross-sectional differences. It has been suggested that changes in affective experience can be better explained by “time left” as opposed to differences in chronological age (Fredrickson & Carstensen, 1990; Gerstorf et al., 2008). Thus, self-rated health was added to reduced models as an indicator of diminishing health, and longitudinal and cross-sectional age trajectories conditional and unconditional on self-rated health were examined.

The same analytic strategy was used for affect optimization. Because of the way poignancy was operationalized, however, statistical analysis of the relationship between age and poignancy followed a different analytical procedure. First, using the longitudinal data, the Pearson correlation between PA and NA was computed at each age. Next, using OLS regression, the relationship between age and poignancy at Time 1 was examined. Linear and quadratic associations were tested, and the best fitting model was chosen by comparing the adjusted R^2 for each model and by examining significance of the parameter estimates. Last, Self-rated health was included in the model to assess whether age differences in poignancy could be explained by between person differences in self-rated health.

Results

Reduced Models

The intra-class correlation (ICC) indicated 87.3% of the variation in PA was attributable to between person variation; 84.6% of the variation in NA came from between person variation. In order to specify an appropriate growth model, a no change, a linear, a quadratic, and six separate piecewise functions were fit to the data. For PA, the results of the likelihood ratio tests suggested the linear model fit the data significantly better than the no change model; the quadratic model fit the data significantly better than the linear model; and the cubic model fit the data significantly better than the quadratic model, $\chi^2(5) = 59.0$, $p < 0.01$. Comparing the models that were not nested (i.e., the cubic model to the best fitting piecewise model), the AIC and BIC estimates suggested that the cubic model fit the data better than the piecewise model (see Table 2). For NA, the linear model fit the data significantly better than the no change model and the quadratic model fit the data significantly better than the linear model for NA, $\chi^2(4) = 84.2$, $p < 0.01$. The cubic model could not be estimated for NA. Comparing the models that were not nested, the AIC and BIC estimates suggested that the quadratic model was a better fit to the data than the best fitting piecewise model (see Table 2).

Further examination of the quadratic model for NA revealed a nonsignificant fixed effect for the quadratic component, $\hat{b}_2 = -.09 \pm 0.08$, p=.25, *ns*. Additionally, the variance of the quadratic term was not significant, $\hat{\sigma}_2^2 = -0.10 \pm 0.29$, p=.72, *ns*. Removing the variance component of the quadratic term resulted in significantly worse model fit, $\chi^2(3) = 94.9$, $p < 0.01$; removing the fixed-effects quadratic term, however, did not result in worse model fit, $\chi^2(1) = 1.3$, *ns*. Thus, in favor of a more parsimonious model, the fixed-effects quadratic term was removed, suggesting that, on average, NA shows a linear trend across adulthood. The retention of the variance component suggests nonlinearity in the intra-individual trajectories. Table 3 and Table 4 provide parameter estimates for the final reduced PA and NA models, respectively.

Positive affect, on average, showed a cubic relationship with age. Focusing on both fixed and random effects, the fixed effect for initial levels of PA at age 28 significantly differed from zero ($\hat{b}_0 = 34.17 \pm 1.02$, $p<.0001$) with inter-individual differences in initial levels of PA approaching significance ($\hat{\sigma}_0^2 = 25.20 \pm 13.12$, p=0.053, *ns*). On average, PA decreased until age 40. After 40, PA increased, peaked at age 67, and then declined into late adulthood (see Figure 1). Additionally, there was significant intra-individual variability around each individual's fitted cubic curve ($\sigma_\varepsilon^2 = 12.21 \pm 0.28$, $p<.0001$).

Negative affect, on average, had a negative linear relationship with age. Again, focusing on both fixed and random effects, the fixed effect for initial levels of NA significantly differed from zero ($\hat{b}_0 = 22.65 \pm 0.44$, $p<.0001$), and there were significant inter-individual differences in initial levels of NA ($\sigma_0^2 = 44.91 \pm 13.84$, p<.01). There were, on average, significant decreases in NA ($\hat{b}_1 = -1.76 \pm 0.12$, p<.0001) with significant between person differences in the rate of change ($\sigma_1^2 = 25.52 \pm 10.22$, $p<.05$). Lastly, there was significant intra-individual variability around each individual's fitted trajectory ($\sigma_\varepsilon^2 = 11.92 \pm 0.26$, $p<.0001$; see Figure 2).

Comparing Reduced and Full Models

Using likelihood ratio tests, the chi-squared statistic showed the full model fit the data significantly better than the reduced model for PA ($\chi^2(4) = 27.5$, $p < 0.002$) and NA ($\chi^2(2) = 55.2$, $p < 0.002$), see Table 5). For PA, Wald tests of the parameter estimates suggested that there were no cross-sectional age differences in the longitudinal trajectories (intercept, $\hat{b}_5$ = −2.17±3.14, p=.49, *ns*; linear term, $\hat{b}_6$ = −0.57±2.02, p=.78, *ns*; quadratic term, $\hat{b}_7$ = 0.36±0.41, p=.38, *ns*; cubic term, $\hat{b}_8$ = −0.06±0.04, p=.16, *ns*; see Table 3). Wald tests for NA suggested that there were significant cross-sectional age differences in the longitudinal trajectories such that those entering the study at different ages at Time 1 showed different intercept values ($\hat{b}_5$ = 2.40±.42, p<.0001, see Table 4).

Incorporating self-rated health as a covariate in the reduced model improved model fit for NA; however, the likelihood ratio test comparing the full and reduced models still suggested the full model fit the data significant significantly better than the reduced model ($\chi^2(5)$ = 34.8, $p < 0.002$, see Table 5), and the significant Wald test remained ($\hat{b}_5$ = 1.90±.45, p<.0001, see Table 3). This suggests that the longitudinal trajectory for NA differed at different cross-sectional ages, beyond the effects of self-rated health.

Self-rated health as a covariate in longitudinal and cross-sectional age-affect trajectories

Focusing on PA, the average linear, quadratic, and cubic longitudinal age associations were significant beyond the effects of self-rated health (see Table 3). The overall shape of the longitudinal trajectory was unchanged controlling for between person differences in self-rated health; PA showed declines reaching a trough at roughly age 38, increased until age 65, and then decreased into latest adulthood (see Figure 1). A notable difference between trajectories conditional and unconditional on self-rated health was that controlling for self-rated health resulted in lower levels of PA across all of the age groups and this downward shift in PA became slightly more pronounced in later adulthood. This suggests that those reporting lower health also report experiencing lower levels of PA and that the influence of between person differences in self-rated health becomes more evident in later adulthood.

Cross-sectional age differences in PA revealed a positive linear relationship between age at Time 1 and PA ($\hat{b}_1$ = 1.00±0.20, p<.0001). Although self-rated health was a significant predictor of PA ($\hat{b}_4$ = −0.94 ±0.12, p<.0001), the positive linear age-related differences remained after controlling for self-rated health ($\hat{b}_1$ = 1.03±0.18, p<.0001). As is suggested by the closeness of the parameter estimates from both models and can be seen in Figure 1, there were minor differences in the cross-sectional age-PA associations conditional and unconditional on self-rated health.

For NA, the average linear decrease in NA with age was beyond the effects of self-rated health ($\hat{b}_1$ = −1.65±0.15, p<.0001, see Table 4). The NA trajectories conditional and unconditional on self-rated health exhibited little differences (see Figure 2). The most pronounced, albeit small, difference in the trajectories was in younger adulthood when controlling for self-rated health resulted in lower levels of NA, and the difference in these trajectories became less evident with age.

Cross-sectional age-differences in NA at Time 1 also showed a significant, negative linear trend ($\hat{b}_1$ = −1.04 ±0.19, p<.0001); however, the decreases in the purely cross-sectional trajectory were smaller than the decreases found in the longitudinal trajectory (see Figure 2). Although the effects of self-rated health were significant ($\hat{b}_4$ = 0.7 ±0.12, p<.0001), controlling for between person differences in self-rated health did not remove age-related differences in NA ($\hat{b}_1$ = −1.09 ±0.18, p<.0001). In fact, the two trajectories showed little differences (see Figure 2). Interestingly, opposite from the longitudinal associations, the most distinct differences in the cross-sectional associations conditional and unconditional on self-rated health were in later adulthood when controlling for self-rated health resulted in lower levels of NA.

Affect Optimization

Following the same procedures used above, the first step in assessing the relationship between affect optimization and age was to find an appropriate change model. The ICC suggested that 92.4% of the variation in optimization was between person. A no change, linear, quadratic, and six separate piecewise functions were fit to the data. The likelihood ratio test suggested that the linear model fit the data significantly better than the no change model; the quadratic model fit the data significantly better than the linear model; and, the cubic model fit the data significantly better than the quadratic model ($\chi^2(5) = 87.9$, $p <$ 0.002, see Table 6). Table 7 provides parameter estimates for the reduced model.

On average, affect optimization showed a cubic relationship with age. The fixed effect for initial levels of optimization significantly differed from zero ($\hat{b}_0$=14.50±1.80, p<.0001) with significant inter-individual differences in initial levels of optimization, $\hat{\sigma}_0^2$=135.61±13.12, p<0.05. Affect optimization, on average, decreased until age 38. After 38, optimization increased, peaking at age 74, and decreased into later adulthood (see Figure 3). Additionally, there was significant intra-individual variability around each individual's fitted cubic curve (σ_ε^2=24.15±0.54, p<.0001). Comparing the reduced and full affect optimization models, the likelihood ratio test suggested that the full model did not fit the data significantly better than the reduced model, $\chi^2(4) = 8.8$, *ns*, see Table 8.

Next, the developmental trajectory of affect optimization was examined controlling for self-rated health. The linear, quadratic, and cubic longitudinal age associations were significant beyond the effects of self-rated health (see Table 7). Furthermore, the overall shape of the longitudinal trajectory was unchanged (see Figure 3). As can be seen in Figure 3, conditional and unconditional trajectories of affect optimization coincided throughout much of adulthood. The only notable difference in the trajectories was in young adulthood when controlling for self-rated health led to lower levels of affect optimization.

Cross-sectional age differences in affect optimization showed a positive linear trend ($\hat{b}_1$ = 2.08 ±0.33, p<.0001). Although self-rated health was a significant predictor of optimization ($\hat{b}_4$ = −1.63 ±0.20, p<.0001), the age-related differences in optimization remained after controlling for between person differences in self-rated health ($\hat{b}_1$ = 2.14±0.29, p<.0001). Controlling for self-rated health resulted in lower levels of affect optimization across all ages (see Figure 3).

Poignancy

Pearson correlations suggested moderate to small negative correlations between PA and NA across all ages (see Figure 4). Examining cross-sectional age differences in poignancy at Time 1 suggested a positive linear relationship between age and poignancy, and the linear model explained 33.3% of the variance in poignancy. Poignancy significantly differed from zero at age 28 ($\hat{b}_0$=−.47±.01, p<.0001) and showed increases from young adulthood into old age ($\hat{b}_1$ = 0.05 ±0.00, p<.0001, see Figure 4). Self-rated health was not a significant predictor of poignancy ($\hat{b}_3$=−0.00±0.00, p=.19).

Discussion

The goal of the present study was to use an accelerated longitudinal design to map the developmental trajectories of positive affect, negative affect, and their association across the adult lifespan. Although previous studies have compared cross-sectional and longitudinal age-affect associations (e.g., Carstensen et al., 2011; Kunzmann et al., 2013), to the best of our knowledge, only one study prior to ours has used an empirical test to validate such comparisons (e.g., Charles et al., 2010). In contrast to this prior finding, (i.e., there was no evidence that a single developmental growth trajectory fit the data), the findings from the current study confirmed developmental trajectories for PA and affect optimization. The longitudinal aging trajectories for NA, however, were not independent of cross-sectional differences. Specifically, our analyses suggested that if the sample had been followed across the entire time frame (i.e., 28-83), individuals entering the study at different ages would have had differences in NA in youngest adulthood.

Our analyses also included an examination of age-related differences in poignancy. PA and NA were found to be less likely to co-occur in younger adulthood. Contrary from expectations, however, PA and NA shared an inverse relationship across most of adulthood, and only became slightly independent in latest adulthood. Overall, the findings from this study help address inconsistencies found in previous investigations of the aging-affect relationship and provide an informative depiction of affective development across adulthood.

Positive and Negative Affect Across Adulthood

Using an accelerated longitudinal design, this study was able to uncover a developmental trajectory for positive affect across adulthood. The trajectory for PA was found to be slightly more complex than the hypothesized trend based on theories of affective aging (Carstensen, 1995; Charles, 2010; Labouvie-Vief & Medler, 2002). As opposed to finding an increase in PA throughout adulthood that leveled off in latest adulthood, this study found a more nuanced association such that decreases in PA were found in earliest adulthood and increases did not occur until roughly 40. Similar to the hypothesized trend, however, increases in PA stabilized and downturns in PA were found after age 65. Although these results do not mirror findings from previous studies combining cross-sectional and longitudinal data, the pattern of results are consistent with and shed light on discrepancies in the pattern of results found in previous studies (Charles et al., 2001; Kunzmann et al., 2013). For example, Kunzmann and colleagues (2013) found decrease in their facet of PA when using a cross-sectional lens, but using the longitudinal data, they found stability in PA until age 65. By incorporating more measurement occasions, the current study was able to uncover a more multifaceted change in PA from ages 28-65 that helps clarify the incongruence between the decline found in the cross-sectional analysis and stability found in the longitudinal analysis.

Currently, more research is needed to better understand the PA-aging relationship in youngest adulthood. Theory and empirical investigations of the aging-affect relationship have been primarily concentrated in later adulthood, but a better understanding of the mechanisms underlying the normative ebb and flow in positive affective experience in younger adulthood can help us better understand differential aging outcomes in later life. These results highlight the advantages of using a lifespan perspective to better understand changes in affective experience and provide an opportunity to start exploring how shifting patterns of PA in young adulthood may influence developmental change in affective experience in later life by investigating how underlying mechanisms such as social relationships, positive events, and cognitive change, either individually or simultaneously, contribute to this developmental process. Future research should investigate both socioemotional and cognitive dimensions to gain a better understanding of how they may influence, or conversely be influenced by, the PA-aging relationship from early adulthood into later life.

Turning our attention to NA, age-related differences were found in the NA-aging trajectories. This limits our ability to generalize the longitudinal trajectory to a developmental phenomenon. The trend found for NA resembled the pattern of results found in previous examinations (e.g., Charles et al., 2001; Kessler & Staudinger, 2009; Mroczek & Christian, 1998; Windsor, Burns, & Boyle, 2012) and is mostly consistent with the theorized pattern of affective development suggesting that adulthood is characterized by declines in NA into later adulthood (Carstensen, 1995; Labouvie-Vief, Diehl, Jain, & Zhang, 2007). Interestingly, however, we did not find an upturn or stabilizing decreases in NA in latest adulthood. This may be due to our predominantly high arousal NA measure. Needed are more longitudinal studies over longer intervals of time to better understand within person change of NA and to tease apart age-related differences from age-related changes in NA.

Affect Optimization and Poignancy

In addition to investigating the individual trajectories of PA and NA, the confluence of PA and NA across the adult lifespan was examined. The longitudinal trajectory for affect optimization represented a developmental trend. Similar to PA, affect optimization showed a cubic relationship with age; different from PA, optimization showed greater increases into later adulthood, peaked later in adulthood, and the decreases in latest adulthood were less pronounced. This suggests that the experience of PA is not only increasing from late-young adulthood into later life but, that individuals experience more positive, relative to negative affect, during this time in life. Even with declines in PA in latest adulthood, oldest age is still characterized by a higher PA to NA ratio than that found in early-midlife and young adulthood. This supports Dynamic Integration Theory and is line with findings from previous studies investigating affect optimization in adulthood (Carstensen et al., 2011; Labouvie-Vief et al., 2007; Labouvie-Vief & Medler, 2002).

Inconsistent with DIT, poignancy showed a linear increase throughout adulthood and the relationship between PA and NA was negative across the entire age range used in the present study. This is indicative of what has been termed *desynchrony*, or a more polarized relationship between PA and NA, and implies that high NA was more likely to be reported in conjunction with low PA (and vice versa; Labouvie-Vief et al., 2007; Pitzer & Bergeman, 2014; Rafaeli, Rogers, & Revelle, 2007). DIT posits that as individuals age, the simultaneous experience of PA and NA should increase into midlife and decrease into later adulthood (Labouvie-Vief et al., 2007). This would suggest an increasing positive correlation between PA and NA, or *synchrony*, into midlife (Rafaeli, Rogers, & Revelle, 2007). The results presented here suggest a lack of complexity across adulthood, and that at best, PA and NA are only becoming more unrelated, or *asynchronous*, as one ages.

Cross-sectional versus Longitudinal Trajectories

Another noteworthy point of discussion from our results is the incongruity between cross-sectional age differences and longitudinal age changes in affective experience across adulthood. Cross-sectional age-affect associations did not accurately represent the complexity of the longitudinal aging-affect associations. Focusing on the differences in the cross-sectional and longitudinal trajectories for PA and affect optimization, the cross-sectional analyses indicated linear increases in each throughout adulthood, not picking up on the dip in young adulthood nor the decline in latest adulthood found when each were examined longitudinally. Consequently, the cross-sectional and longitudinal results reveal two entirely different processes and outcomes. Moreover, even with the influence of cross-sectional age differences in the overall longitudinal trajectory of NA, the purely cross-sectional NA trajectory still diverged from the longitudinal trajectory showing much higher levels of NA in later adulthood.

In an attempt to explain cross-sectional and longitudinal disassociations, self-rated health was incorporated into our models. Despite previous research and theory suggesting that affect-aging links can be better explained by "time left" as opposed to chronological age (e.g., Carstensen et al., 2011; Gerstorf et al., 2008), our proxy for declines in health that accompany the aging process, self-rated health, did not fully account for aging-affect associations. Controlling for self-rated health resulted in minimal cross-sectional age differences and longitudinal age change in affective experience. Moreover, between person differences in self-rated health did not help explain cross-sectional age differences in the longitudinal aging trajectories of NA. The results from these analyses further underscored the importance of discerning within person change from between person age differences.

Limitations

Several limitations of the present study should be noted. First, Robinson and Clore (2002) posit in the Accessibility Model of Emotional Self-report that there are different cognitive processes underlying an individual's self-report of affective experience and these cognitive processes dependent on the time frame used to assess an individual's experience of emotion (e.g., past few weeks, right now, in general). The present study used a generalized self-report measure of affect. Generalized measures of affective experience tap an individual's beliefs about their affective experiences as opposed to their actual experiences of affect. Nevertheless, beliefs about affective states are often grounded in emotional experiences over time (Russell & Feldman, 1999), and the results found in this study are similar to results found in another study using a momentary assessment of affect (i.e., Carstensen et al., 2011), which has been shown to be related to experiential knowledge (Robinson & Clore, 2002). Thus, although the measure of affect used in the current study may not directly assess day-to-day, moment-to-moment affective experience, the study provides insight into individuals' changing beliefs about their affective experiences, which, in turn, is related to their actual experiences of affect.

A second limitation is that the measures of PA and NA used in the present study are high arousal affect items (Watson, Clark, & Tellegen, 1998). Several studies have found age-related differences for reports of high versus low arousal affect (Kessler & Staudinger, 2009; Windsor et al., 2012). Additionally, other studies have suggested that older adults, compared to younger adults, experience negative high arousal affect as more unpleasant and positive high arousal affect as less pleasant (Streubel & Kunzmann, 2011). Thus, it is plausible that the age-related changes in PA and NA are the result of a shift away from high arousal affect; if this was the case, however, the same declining pattern of results would be expected for PA and NA which was not found here. Nonetheless, more research investigating the developmental trajectories for low arousal PA, NA, and their concurrence is needed.

Third, in the interpretation of our results it is important to note that the distribution of negative affect was positively skewed, with high kurtosis indicating that majority of the NA observations were low levels of NA. This may have influenced our estimates of affect optimization and poignancy. Our correlations for poignancy may have remained negative throughout adulthood because there was less variability in NA.

Separate, however, relatedly, our operationalization of affect optimization and poignancy are only one way to conceptualize these constructs and is a fourth caveat of the present study. Previous research has used other metrics to operationalize affect optimization and poignancy. For example, Labouvie-Vief and colleagues (2007) used measures created to directly assess individuals' levels of affect optimization and affect complexity (a broader construct under which poignancy would fall). Thus, other measures of affective complexity and poignancy may yield a different pattern of results.

Fifth, our study of poignancy was limited to inter-, or between person, correlations for PA and NA as opposed to intra-, or within person, correlations. It should be noted, however, that the between person correlations include longitudinal measurements from individuals, consistent with the ages at which they provided data. Thus, the results presented here are a combination of within and between person information. The specific statistical analysis used (i.e., OLS regression), however, does not allow for the separation of between and within person associations, and as has been shown, analyses of between person differences oftentimes do not necessarily resemble analyses of within person change (Singer & Willett, 2003).

Lastly, as is the case in any longitudinal study, the current study does not overcome limitations associated with the historical context during which the data was the collected. The propositions of our results may be influenced by broad contextual factors such as the Great Recession that occurred during the span of the current study. For PA and affect optimization, we found no age-related differences in age-related change This suggests that affective change for individuals at different ages in our study was not differentially impacted by such contextual factors—supporting the generalizability of our findings.

Conclusions

Through the use of an accelerated longitudinal design, this study was able to model the developmental trajectories of PA and affect optimization across the adult lifespan. Although slightly more nuanced, these trajectories lend support to theories of affective aging and provide further evidence for nonlinear change in affective well-being from young adulthood into later life. This research provides a foundation for future research investigating the dynamics of related variables, such as social activity, stress, or dispositional resilience, that may be influenced by, or contribute to, changes in affect. In turn, this will allow for a better understanding of how affect and related variables come together across the adult life course to influence health and well-being outcomes in later adulthood.

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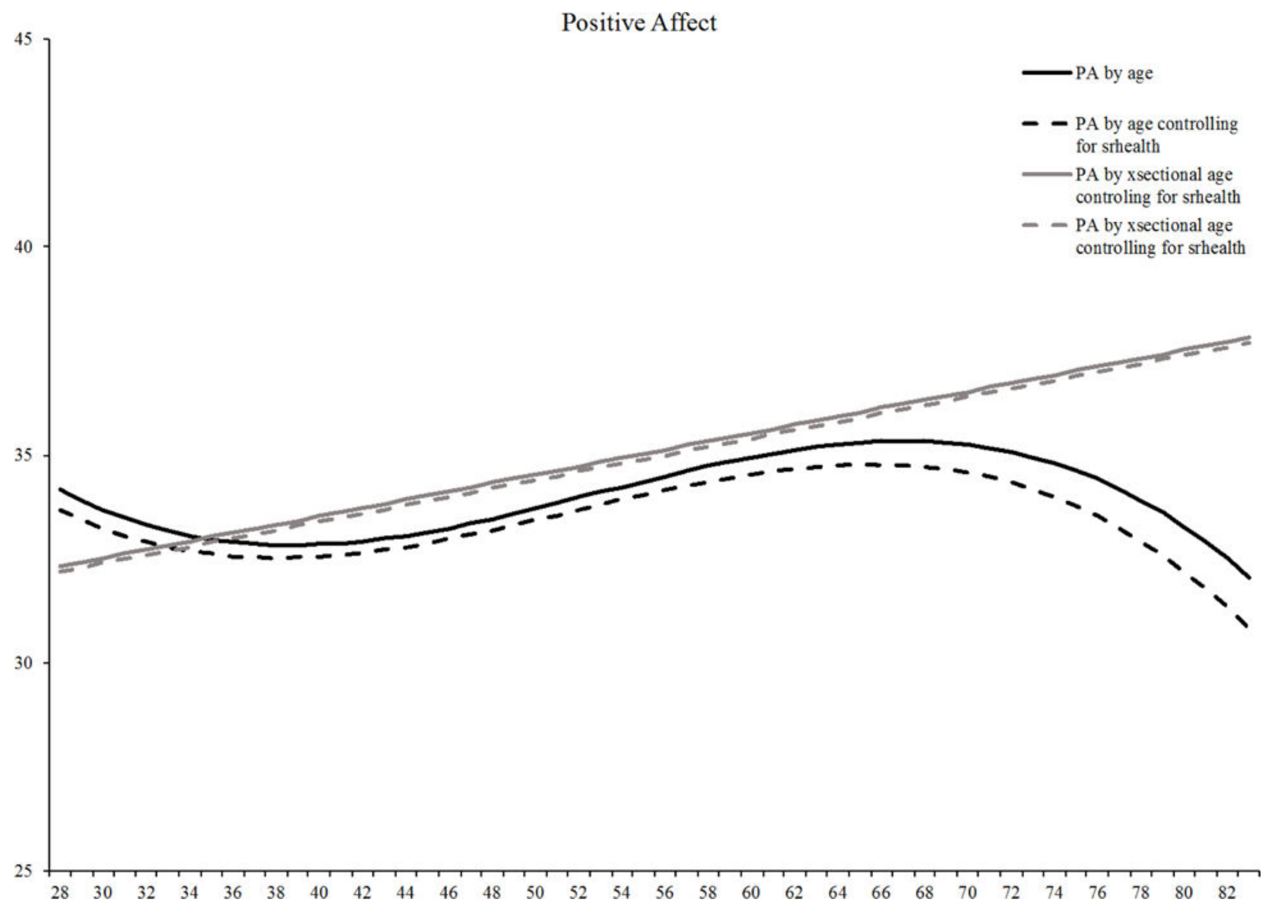

Figure 1.
Longitudinal and cross-sectional trajectories of positive affect from ages 28–83

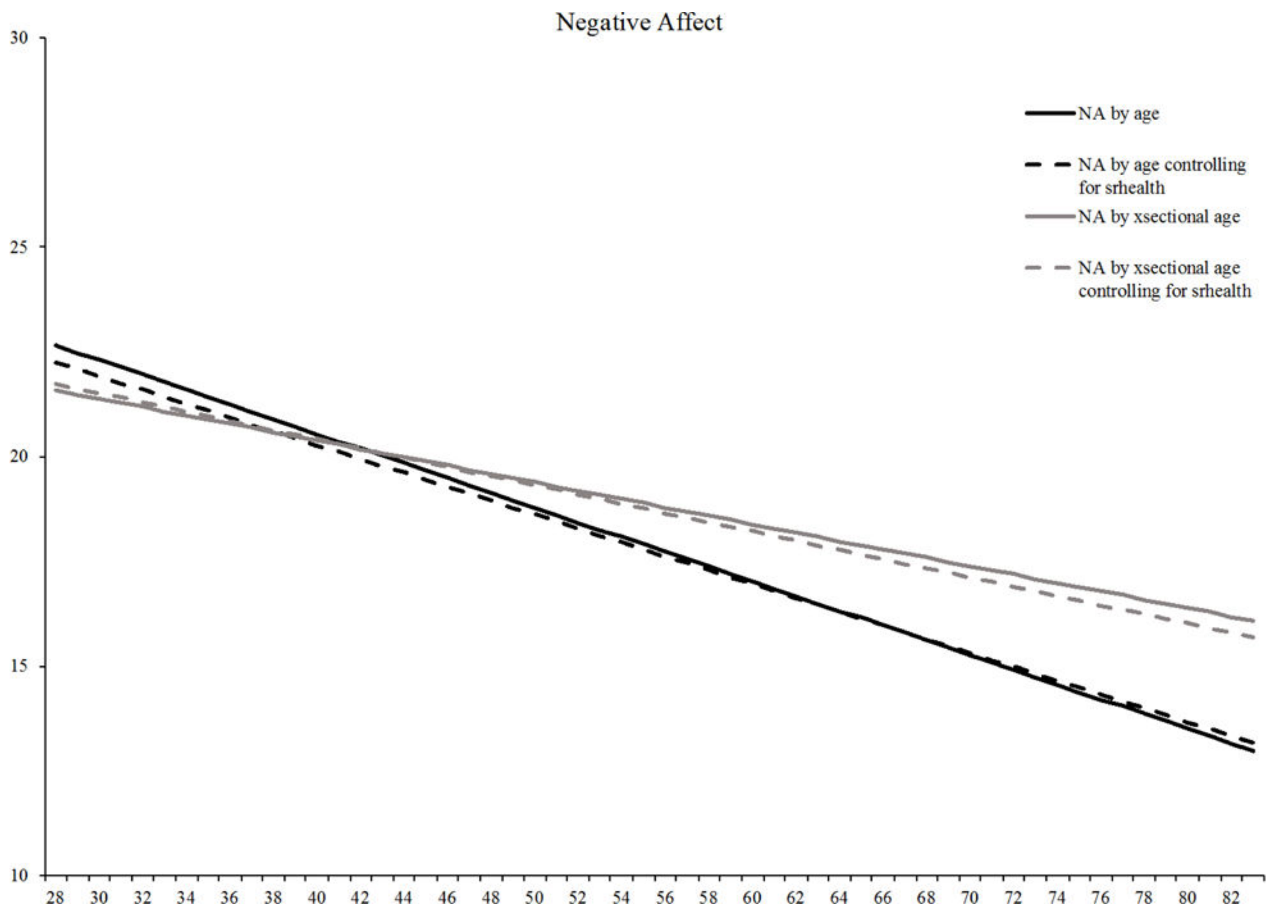

Figure 2.
Longitudinal and cross-sectional trajectories of negative affect from ages 28–83

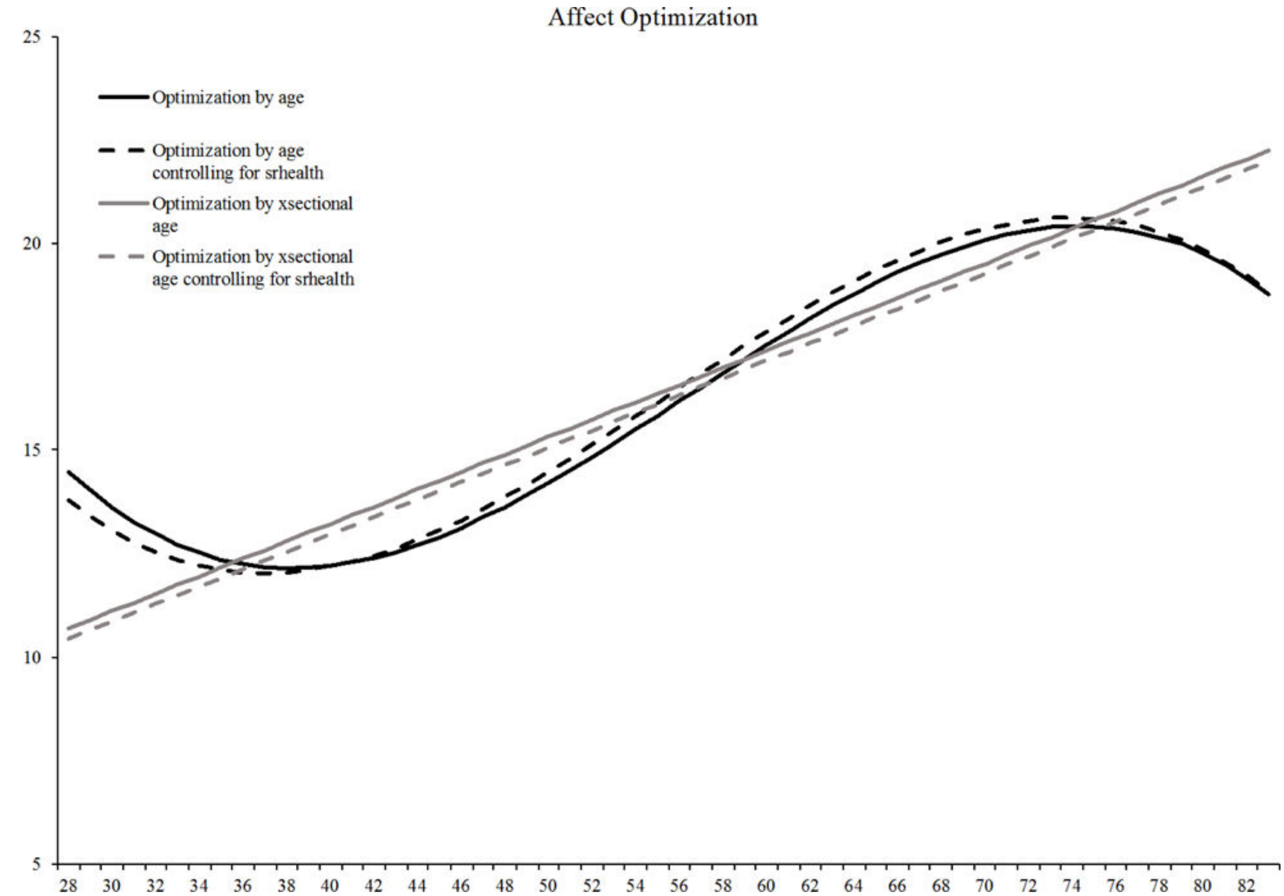

Figure 3.
Longitudinal and cross-sectional trajectories of affect optimization from ages 28–83

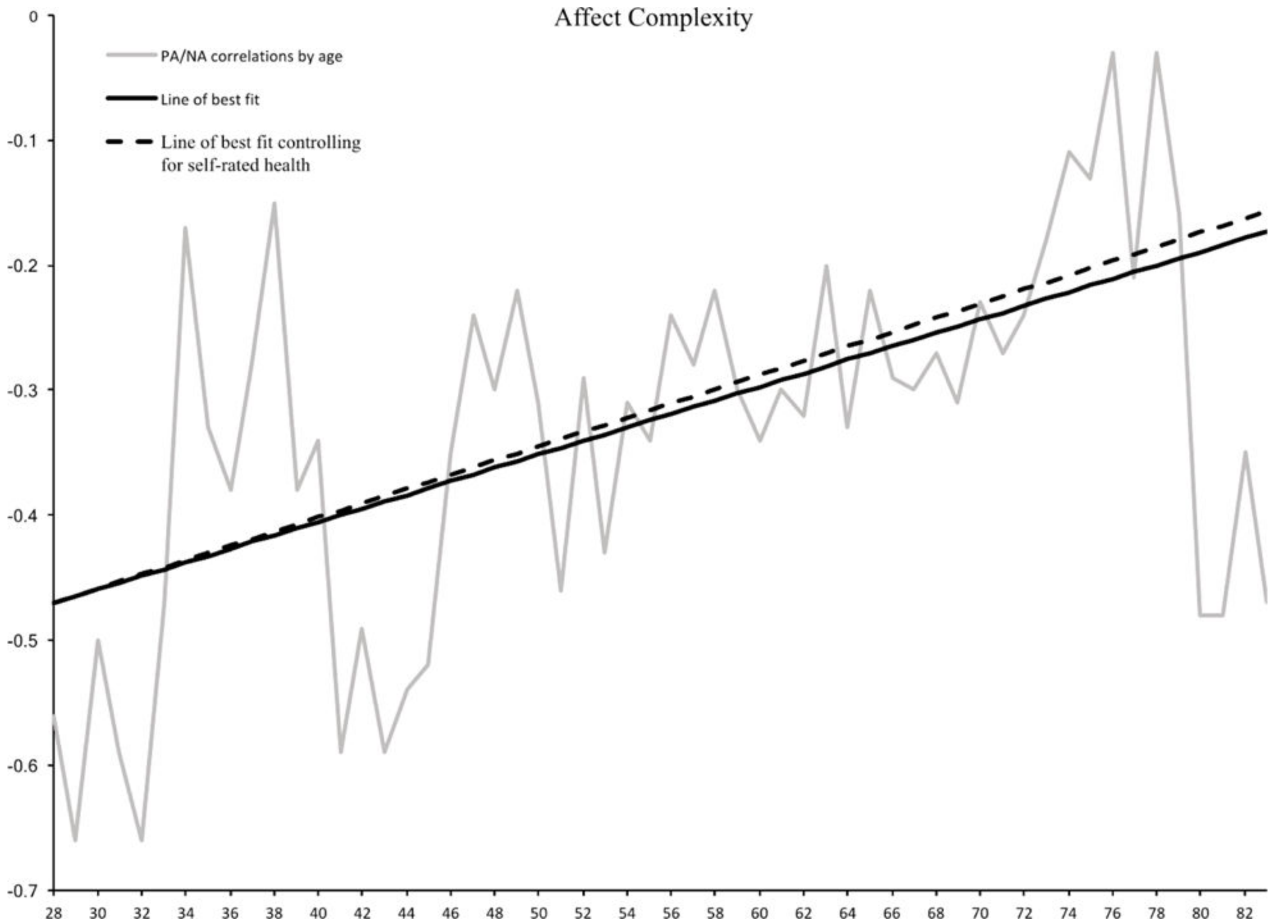

Figure 4.
Cross-sectional trajectories of affect complexity from ages 28–83

Table 1

Sample Characteristics: Age, Gender, Income, Marital Status, Education, Self-rated Health

	Time 1	Time 2	Time 3	Time 4	Time 5	Time 6	Time 7	Time 8	Time 9	Time 10
N	1019	1022	1025	1024	1024	1021	1024	1024	1020	1005
Mean age	55.32	56.23	57.17	58.12	59.12	60.07	61.00	61.90	62.90	63.61
Percent Female	61.0%	61.28%	62.15%	62.04%	61.71%	62.57%	63.27%	62.96%	63.93%	63.54%
Household Income										
>$7500	4.40%	5.21%	4.83%	4.41%	5.88%	5.32%	5.37%	2.88%	3.04%	5.05%
$7,500-$14,99	11.00%	11.46%	11.86%	11.70%	13.55%	15.59%	15.51%	14.86%	14.95%	14.10%
$15,000-$24,999	14.31%	13.28%	15.31%	15.65 %	18.00%	18.06%	18.89%	18.40%	19.63%	17.29%
$25,000-$39,999	21.73%	20.85%	20.28%	20.06%	20.50%	22.24%	18.69%	23.28%	20.79%	20.74%
$40,000-$74,999	31.50%	30.86%	28.55%	29.48%	26.92%	23.00%	26.84%	25.50%	26.64%	26.86%
$75,000-$99,999	9.22%	10.42%	10.90%	11.09%	9.09%	9.70%	9.54%	9.76%	9.11%	9.84%
>$100,000	7.84%	8.72%	21.92%	7.60%	6.06%	6.08%	5.17%	5.32%	5.84%	6.12%
Marital Status										
Single	15.99%	15.95%	14.88%	12.86%	12.90%	13.84%	12.04%	11.21%	11.47%	10.99%
Married	50.54%	50.68%	51.01%	50.07%	45.41%	43.17%	45.44%	45.69%	46.10%	46.60%
Separated	1.76%	1.76%	1.49%	1.35%	1.41%	1.66%	1.17%	1.29%	1.38%	1.31%
Widowed	9.76%	9.73%	10.69%	12.26%	15.90%	15.31%	15.53%	16.81%	17.89%	17.28%
Divorced	21.95%	21.89%	21.92%	23.47%	24.38%	26.01%	25.83%	25.00%	22.94%	23.82%
Education Level										
>High School	2.56%	2.04%	1.88%	2.08%	2.52%	2.01%	2.50%	1.73%	1.37%	1.83%
High School	28.94%	27.55%	29.70%	29.04%	32.87%	32.66%	31.35%	31.18%	31.51%	30.68%
Vocational	6.46%	5.74%	4.70%	6.52%	5.77%	6.42%	5.96%	6.45%	7.53%	7.85%
Some College	26.24%	27.30%	25.81%	22.96%	26.22%	24.77%	25.58%	26.45%	26.26%	23.30%
College Degree	22.07%	22.96%	21.91%	23.26%	18.01%	18.53%	18.65%	17.85%	17.12%	18.85%
Post College	5.79%	6.12%	6.72%	6.07%	5.24%	6.61%	7.12%	6.45%	5.94%	7.85%
Graduate/Medical/Law	7.94%	8.29%	9.27%	10.07%	9.27%	8.99%	8.85%	9.89%	10.27%	9.69%

Table 2

Fit Indices for Reduced NA and PA Models

	No change	Linear	Quadratic	Cubic	Piecewise
Positive Affect					
−2LL	34272.9	34196.6	34065.5	34006.5	34246.4
# of parameters	3	6	10	15	10
AIC	34278.9	34208.6	34065.5	34036.5	34166.4
BIC	34293.7	34238.3	34134.8	34110.5	34215.8
Negative Affect					
−2LL	34124.7	33829.1	33731.7		34186.6
# of parameters	3	6	10		10
AIC	34130.7	33841.1	33731.7		33754.5
BIC	34145.5	33870.7	33801.1		33823.8

Note. −2LL= −2 log likelihood; BIC= Bayesian Information Criterion; AIC=Akaike Information Criterion.

The best fitting piecewise models for PA and NA were at ages 55 and 50, respectively.

Table 3

Growth Models for Positive Affect

		PA	PA[a]	PA[b]
Fixed Effects:	Intercept b_0	34.17***	33.17***	33.68***
	Age, b_1	−2.75*	−1.73	−2.50*
	Age^2, b_2	1.64**	−0.20	1.57**
	Age^3, b_3	−0.22***	0.09	−0.22***
	Self-rated health, b_4			−1.24***
	Age1, b_5		2.17	
	Age1 × Age, b_6		−0.57	
	Age1 × Age^2, b_7		0.36	
	Age1 × Age^3, b_8		−0.06	
Variance: Level-1:	σ_e^2	11.96***	11.93***	11.78***
Level-2:	Intercept, σ_0^2	25.20	25.72	11.45
	Age, σ_1^2	199.27**	206.86***	229.34***
	Age^2, σ_2^2	6.91	8.27	8.75
	Age^3, σ_3^2	−0.04	−0.03	−0.06
	Covariance σ_{01}	33.56	30.86	29.85
	Covariance σ_{02}	−134.49***	−133.60	−144.59***
	Covariance σ_{03}	26.72**	27.15**	30.50***
	Covariance σ_{12}	−11.61	−14.76	−16.28
	Covariance σ_{13}	−6.82*	−6.81	−8.07**
	Covariance σ_{23}	0.39	0.31	−0.06

Note. PA[a] is the full model. PA[b] is the reduced model controlling for self-rated health.

Unstandardized estimates are presented. Age and Age1 are centered at age 28; slope is scaled in units per decade.

* p<.05,

** p<.001,

*** p<.0001

Table 4

Growth Models for Negative Affect

		NA	NA[a]	NA[b]	NA[c]
Fixed Effects:	Intercept b_0	22.65***	21.49***	22.24***	21.71***
	Age, b_1	−1.76***	−3.52	−1.64***	−3.47***
	Self-rated health, b_4			0.53***	0.60***
	Age1, b_5		2.40***		1.90***
	Age1 × Age, b_6		−0.00		0.07
Variance: Level-1:	σ_e^2	11.92***	11.85***	11.70***	11.66***
Level-2:	Intercept, σ_0^2	44.92**	48.90***	28.98*	31.69***
	Age, σ_1^2	25.52*	31.39**	21.04***	2.55*
	Age^2, σ_2^2	0.07	0.29	0.03	0.19
	Covariance σ_{01}	−7.14	−13.97	0.41	−4.39
	Covariance σ_{02}	−9.62**	−7.55**	−10.31**	−8.61**
	Covariance σ_{12}	−0.61	−1.91	−0.16	−1.13

Note. NA[a] is the full model. NA[b] is the reduced model controlling for self-rated health. NA[c] is the full model controlling for self-rated health. Unstandardized estimates are presented. Age and Age1 are centered at age 28; slope is scaled in units per decade.

* $p<.05$,

** $p<.001$,

*** $p<.0001$

Table 5

Fit Indices for Full PA and NA Models

	PA[a]	NA[a]	NA[c]
Goodness of fit			
−2LL	33979.0	33677.8	25791.3
AIC	34017.0	33699.8	25819.3
BIC	34110.8	33754.1	25883.8
df	4	2	5
χ^2	27.5*	55.2*	34.8*

Note

*$p < .002$

Table 6

Fit Indices for Reduced Affect Optimization Models

	No change	Linear	Quadratic	Cubic	Piecewise
Goodness of fit					
−2LL	38644.7	38445.5	38310.3	38222.4	38353.3
# of parameters	3	6	10	15	10
AIC	38650.7	38457.5	38310.3	38252.4	38373.3
BIC	38665.5	38487.1	38379.6	38326.5	38422.6

Note. −2LL= −2 log likelihood; BIC= Bayesian Information Criterion; AIC=Akaike Information Criterion.

The best fitting piecewise model was when age=55.

Table 7

Growth Models for Affect Optimization

		Optimization	Optimization[a]	Optimization[b]
Fixed Effects:	Intercept b_0	14.50***	11.25***	13.79***
	Age, b_1	−4.97*	5.89	−4.20*
	Age^2, b_2	2.97***	−1.65	2.80**
	Age^3, b_3	−0.35***	0.18	−0.34***
	Self-rated health, b_4			−2.29***
	Age1, b_5		−1.78	
	Age1 × Age, b_6		−2.00	
	Age1 × Age^2, b_7		−1.23	
	Age1 × Age^3, b_8		−0.15*	
Variance:	Level-1: σ_ε^2	24.15***	24.14***	24.02***
Level-2:	Intercept, σ_0^2	135.61*	130.70*	73.09
	Age, σ_1^2	623.14**	580.41*	722.02***
	Age^2, σ_2^2	33.75	28.87	42.15
	Age^3, σ_3^2	0.09	0.05	0.03
	Covariance σ_{01}	−12.66	−1.42	−8.87
	Covariance σ_{02}	−295.81***	−291.17***	−332.36***
	Covariance σ_{03}	63.79**	61.71**	−77.82***
	Covariance σ_{12}	−76.16	−64.16	−95.14
	Covariance σ_{13}	−12.61	−12.13	−16.97*
	Covariance σ_{23}	−0.69	−0.33	−0.43

Note. Optimization[a] is the full model. Optimization[b] is the reduced model controlling for self-rated health. Unstandardized estimates are presented. Age and Age1 are centered at age 28; slope is scaled in units per decade.

* *p<.05,*

** p<.001,

*** p<.0001

Table 8

Fit Indices for Full Affect Optimization Models

	Optimization
Goodness of fit	
−2LL	38213.6
AIC	38251.6
BIC	38345.4
df	4
χ^2	8.8 *ns*