THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Psychological Sciences
cite as: *J Gerontol B Psychol Sci Soc Sci*, 2017, Vol. 00, No. 00, 1–11
doi:10.1093/geronb/gbx116
Advance Access publication September 28, 2017

OXFORD

Original Research Report

Age and the Factor Structure of Emotional Experience in Adulthood

Susan T. Charles, PhD[1] Jacqueline Mogle, PhD[2] Kate A. Leger, MA[1] and David M. Almeida, PhD[3]

[1]Department of Psychology and Social Behavior, University of California, Irvine.[2]College of Nursing, Pennsylvania State University, State College. [3]Department of Human Development and Family Studies, Center for Healthy Aging, Pennsylvania State University.

Address correspondence to: Susan Charles, Department of Psychology and Social Behavior, 4326 Social and Behavioral Sciences Gateway, University of California, Irvine, CA 92697-7085. E-mail: scharles@uci.edu

Received: February 12, 2016; Editorial Decision Date: August 15, 2017

Decision Editor: Bob G. Knight, PhD

Abstract

Objectives: The current study examined the factor structure of emotional experience across adults 34–50, 51–65, and 66–84 year olds.

Method: Participants (N = 2,022) were asked about 14 negative and 13 positive emotions across 8 days in the National Study of Daily Experiences II study. Factor analysis computed both inter-individual factors (between-person structure of emotional experience) and intra-individual factors (factors describing emotions in daily life) for each age group.

Results: For inter-individual variation, one positive and one negative factor captured emotions experienced for the first two age groups, but the 66 to 84-year-old adults had an additional factor for anger. For intra-individual variation, two factors (fear and sadness; anger) captured negative emotions for the first two age groups. The oldest age group had three negative factors: fear; anger (with additional sadness emotions); and sadness. Four factors captured positive emotions for the middle-aged groups and three for the oldest group; interpersonally oriented emotions (e.g. sense of belonging) were the primary sources of age differences.

Discussion: Findings suggest that subtle age differences exist in the factor structure of daily emotional experience when comparing middle-aged and older adults.

Keywords: Affect, Emotion, Factor analysis, Inter-individual differences.

Researchers have become increasingly interested in studying age differences in the emotions of daily life. The resulting diary and momentary sampling studies have revealed age differences in various aspects of emotional experience, such as mean levels of positive and negative affect (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Charles et al., 2016); the degree to which emotions fluctuate from day to day (Brose, Scheibe, & Schmiedek, 2013); and how emotions vary in relation to daily stress processes (e.g., Scott, Ram, Smyth, Almeida, & Sliwinski, 2017). Many studies include a few emotions that capture high and low arousal experiences (e.g., Scott et al., 2017; Wrzus, Müller, Wagner, Lindenberger, & Riediger, 2013). Other studies include a greater number of emotions (Carstensen et al., 2000; Hay & Diehl, 2011), but studies that examine age differences in emotional experience—captured by lists of emotion words—often rely on the necessary assumption that the factor structure of daily emotional experience is similar across different age groups.

Emotion theorists emphasize the importance of sociocultural and demographic factors in shaping emotional experience (De Leersnyder, Boiger, & Mesquita, 2013). Age

is one of those demographic factors, yet its potential association with the factor structure of emotional experience is rarely studied. The current study uses 8 days of data from a large sample of adults, ranging from 34 to 84 year olds, to examine whether the types of emotions people experience over the course of the week (inter-individual variation) as well as how emotions cluster together on a daily basis (intra-individual variation) vary by age group.

Inter-Individual Variation

Collecting multiple emotion reports across many time points spanning days or even weeks allows researchers insight into how emotions are experienced together. For example, analyses may reveal that people generally experience two types of negative emotions: one type including anxiety and sadness emotions, and the other characterized by anger-related emotions. Researchers would then differentiate people based on these two types of emotion-clusters, perhaps with phrases such as, "She is a very angry person, but he is more often anxious and sad." If, however, these emotions were clustered together on one factor, people would be compared based on their overall levels of negative affect as opposed to differences in discrete negative emotions, such as sadness.

Several studies have found that one positive factor and one negative factor characterize emotional experiences for both younger and older adults (e.g., Diener, Larsen, Levine, & Emmons, 1985; Grühn, Lumley, Diehl, & Labouvie-Vief, 2013; Hülür, Hoppmann, Ram, & Gerstorf, 2015; Maitland, Dixon, Hultsch, & Hertzog, 2001). These null age effects are consistent with the premise that emotional experience remains robust and invariant across old age (Levenson, Carstensen, Friesen, & Ekman, 1991). In studies that include a larger number of emotion items and emotions that vary in arousal, however, researchers have found subtle age differences (e.g., Kessler & Staudinger, 2009; Lawton, Kleban, Rajagopal, & Dean, 1992; Grühn et al., 2013). For example, the high arousal positive emotion, "enthusiastic" was dropped from a model to allow age invariance in factor structure (Kessler & Staudinger, 2009).

Intra-Individual Variation

In addition to inter-individual variation, the current study also examines factors that characterize how emotions are structured on a daily basis. These types of factors capture intra-individual variation and are calculated by examining which emotions cluster with one another from day to day (Rush & Hofer, 2014). For example, if reports of negative emotions always correlate highly with one another on any given day, one factor would be sufficient to characterize daily negative experiences. If, however, people reported some days that are more characterized by anger-related emotions and others by sadness-related emotions, then two different factors describe daily negative experiences.

Importantly, intra-individual variability factors capture a different phenomenon from inter-individual variability factors. For example, groups of people can vary from one another on levels of negativity, and one inter-individual factor could capture this difference. From day to day, however, people's emotions could align along three clusters, where days vary based on their feelings of anger, anxiety, and sadness. Understanding the intra-individual variation of daily experience, then, is important for understanding how emotions are experienced from day to day, and whether age differences exist in these experiences.

Emotion researchers have raised the possibility that age differences exist in intra-individual factors of emotional experience. Differential Emotions Theory posits that basic emotions retain their discrete functions and structure across the life course, but that emotions become "more complex and nuanced" (p. 303) with a more elaborated pattern of emotional experience with age (Magai, Consedine, Krivoshekova, Kudadjie-Gyamfi, & McPherson, 2006). As such, people may report experiencing different types of emotions at the same time more often in older age. Consistent with this view, a more recent study found that when viewing facial expressions, older adults used a greater number of emotional components to describe an expression than did younger adults (Kim, Geren, & Knight 2015). This study focused on age differences in response to emotional stimuli, and not experienced emotions. The dynamic structure of daily emotional experience—or the intra-individual structure of emotion—may also show subtle differences with age.

Using socioemotional selectivity theory, researchers have posited that the awareness that time in life is growing shorter increases the frequency of emotional poignancy, which in turn gives rise to more variations and mixes of daily emotional experiences among older than younger adults (Carstensen et al., 2000; Ersner-Hershfield, Mikels, Sullivan, & Carstensen, 2008). In one study, people reported their experience of nineteen different emotions five times daily for a week, and from these reports researchers calculated each person's individual factor structure of daily emotions (Carstensen et al. 2000). They found that older age correlated with a greater number of factors. Another study, however, found that four factors captured the daily experiences of older and younger adults (as assessed by ratings of emotions from the Positive and Negative Affect Scale (PANAS); Grühn et al., 2013).

The Current Study

The current study examined age differences in the multilevel factor structure of 27 emotions—positive and negative—reported across 8 days by individuals ranging from 35 to 84 years old. We calculated both intra and inter-individual factors for people in the first half of midlife (35–50 year olds), later midlife (51–65 year olds), and older adults (those 66 and older). Three age groups allowed us to

examine both linear and quadratic age differences. A further strength of the study was the inclusion of low arousal positive emotions (such a calm and peaceful and sense of belonging) that are not often included in studies but are arguably more salient for the lives of older adults than younger adults (e.g., Scheibe, English, Tsai, & Carstensen, 2013). This study builds on prior research by providing the largest, most extensive analyses of how emotions are clustered together in daily life for midlife and older adults. Findings will inform theory regarding how daily emotional experience may vary (or not) by age in adulthood, and direct future investigators who must decide the types and numbers of emotions to include in daily studies of emotional experience in adulthood.

Methods

Sample and Procedure

The current study used data from the Midlife in the United States Survey (MIDUS II; for a description, see Radler & Ryff, 2010). A subset of participants (N = 2,022) completed the National Study of Daily Experiences (NSDE II). The NSDE II consisted of daily telephone interviews across 8 days asking about their daily experiences. People ranged from 35 to 84 year olds. In the current study, they were divided into groups aged 35–50 (n = 731; n_{days} = 5,246), 51–65 (n = 753; n_{days} = 5,595), and 66–84 year olds (n = 538; n_{days} = 4,054). Other demographic characteristics were similar across the three groups. Approximately 57% of each age group was female (57.7, 56.7%, 57.3%, respectively), and all were primarily Caucasian (84%, 86.5%, and 89.8%). The percent of those with at least a high school degree (72.5%, 71.3%, 61.9%), was significantly lower among the oldest group compared to the two others, $\chi^2(2) = 18.8$, $p < .01$.

Measures

Daily emotional experience

Participants reported how much of the time each day they had felt each of 13 positive (cheerful, in good spirits, extremely happy, calm and peaceful, satisfied, full of life, enthusiastic, attentive, proud, active, close to others, like you belong, and confident) and 14 negative (worthless, so sad nothing could cheer you up, nervous, restless or fidgety, hopeless, that everything was an effort, worthless, afraid, jittery, irritable, ashamed, upset, lonely, angry, and frustrated) emotional experiences using the following scale: 0 = none of the time, 1 = a little of the time, 2 = some of the time, 3 = most of the time, 4 = all of the time.

Analytic Strategy

Analyses were conducted in a series of three steps separately for each age group. First, we computed descriptive statistics, including the intraclass correlations (ICCs) for individual items. ICCs are the proportion of variance due to between person differences relative to the total variance and provide an index of the extent to which items vary across individuals as well as within individuals across days. This is an important first step to determine whether sufficient variability exists at both levels of analysis. We then examined the intercorrelations at both the inter- and intra-individual levels among items. Finally, we conducted multilevel exploratory factor analyses (MEFA; Mogle, Almeida, & Stawski, 2015; Muthén, 1984) on the age groups to examine the underlying structure for these scales.

MEFA simultaneously estimated separate inter-individual and intra-individual factor structures. The inter-individual factor structure is interpreted as one would typically interpret a traditional exploratory factor analysis (EFA). The factors represent how items cluster together across individuals. The intra-individual factor structure is novel in that it tests how items cluster together across days. As with traditional EFA, eigenvalues are used to evaluate which solution provides a best fit to the data. In addition, model fit statistics are evaluated to confirm the appropriateness of the selected solution. In the current analyses, we used the comparative fit index (CFI; Bentler, 1990), Tucker Lewis Index (TLI; Bentler, 1990), Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1999) and root mean square area of approximation (RMSEA; Browne & Cudek, 1993). The model χ^2 was not used to evaluate overall fit due to its sensitivity to small deviations in large sample sizes. Acceptable values for each index were as follows: CFI and TLI greater than 0.9; SRMR and RMSEA below 0.08. Given that the negative emotions were highly skewed (minimum skew = 2.099 to a maximum skew = 11.027), all negative emotions were treated as categorical in these models (Muthén, 1984). The estimation methods for continuous data do not apply to variables that are categorical in nature (Wirth & Edwards, 2007). Given the skewed nature of the negative affect items, treating them as categorical would ensure proper estimation of factor loadings, means, and correlations. Additionally, the dependent nature of the daily observations indicates the need for a model that can account for links among observations originating from the same individual. Multilevel EFA with the robust weighted least square means available in MPLUS allows the most appropriate estimation under these conditions (Muthén & Muthén, 2007). The positive emotions were generally normally distributed and treated as continuous measures (maximum skew = 1.4).

Initial solutions were interpreted using Kaiser's rule for accepting factors with eigenvalues over 1. Examination of the model fit indicators and factor loadings guided whether the model solution was further interpreted. When considering alternative models, changes in the CFI and RMSEA were used. Chen (2007) recommended

considering increases of .01 for the CFI and decreases of .015 for the RMSEA as indicating significant improvement in model fit. When interpreting factors and factor loadings for intra-individual solutions, a cutoff of .3 was used. There is additional power in the inter-individual analysis due to the increased precision of measurement at this level: multiple observations per person decreases the measurement error for a person-specific estimate (Hox, Moerbeek, & van de Schoot, 2010). Due to the additional power in the inter-individual solution, we used a more conservative 0.4 cutoff value.

Results

Table 1 presents descriptive statistics by age group. Consistent with research using these data, the 66–84-year-old age group had lower average scores on most of the NA items; these differences were significant except for the items "worthless", "hopeless", and "everything was an effort." Age groups were significantly different on all PA items, with older groups having higher average scores. Full correlation tables are available as supplementary information from the authors. As expected, items were positively correlated with other items measuring the same affect and negatively correlated with items measuring opposing affect. Inter-individual correlations were stronger than intra-individual correlations and patterns were consistent across all three age groups.

Model Selection in the MEFA

The eigenvalues for the factor solutions for each of the different age groups appear in Figure 1. For all three age cohorts, more factors were uncovered at the intra-individual level than the inter-individual level. Eigenvalues were used in conjunction with model fit statistics and

Table 1. Descriptive Statistics for Positive and Negative Affect Items

	34–50 year olds				51–65 year olds				66–84 year olds			
Item	Mean	Inter SD	Intra SD	ICC	Mean	Inter SD	Intra SD	ICC	Mean	Inter SD	Intra SD	ICC
Negative affect												
Restless	0.431	0.502	0.648	0.459	0.362	0.425	0.607	0.458	0.348	0.389	0.577	0.456
Nervous	0.282	0.393	0.545	0.451	0.260	0.373	0.515	0.507	0.226	0.337	0.479	0.504
Jittery	0.147	0.285	0.404	0.570	0.146	0.306	0.399	0.565	0.104	0.213	0.354	0.548
Irritable	0.417	0.458	0.628	0.455	0.249	0.346	0.507	0.452	0.181	0.247	0.441	0.450
Upset	0.355	0.373	0.629	0.382	0.263	0.304	0.557	0.386	0.201	0.266	0.477	0.407
Angry	0.286	0.333	0.571	0.374	0.180	0.240	0.469	0.360	0.108	0.144	0.370	0.338
Frustrated	0.592	0.459	0.695	0.378	0.450	0.447	0.640	0.415	0.324	0.330	0.561	0.383
Afraid	0.082	0.246	0.301	0.627	0.052	0.142	0.262	0.573	0.032	0.144	0.184	0.613
Worthless[a]	0.077	0.262	0.322	0.623	0.062	0.242	0.268	0.697	0.067	0.182	0.300	0.542
So sad nothing could cheer up	0.076	0.267	0.311	0.676	0.060	0.218	0.293	0.642	0.044	0.114	0.249	0.508
Hopeless[a]	0.087	0.286	0.310	0.768	0.070	0.292	0.287	0.736	0.042	0.163	0.238	0.709
Lonely	0.169	0.431	0.390	0.800	0.130	0.430	0.315	0.845	0.117	0.324	0.344	0.760
Ashamed	0.050	0.162	0.260	0.576	0.035	0.173	0.194	0.742	0.020	0.046	0.166	0.360
Everything an effort[a]	0.327	0.588	0.580	0.621	0.258	0.558	0.518	0.657	0.246	0.503	0.556	0.615
Positive affect												
In good spirits	2.852	0.599	0.626	0.478	3.036	0.610	0.588	0.518	3.132	0.534	0.624	0.423
Cheerful	2.652	0.732	0.662	0.550	2.862	0.734	0.627	0.578	3.007	0.636	0.643	0.494
Extremely happy	1.726	1.037	0.747	0.658	2.000	1.110	0.777	0.671	2.206	1.051	0.848	0.606
Satisfied	2.709	0.734	0.655	0.557	2.935	0.698	0.599	0.576	3.088	0.604	0.599	0.505
Calm/peaceful	2.586	0.730	0.717	0.509	2.830	0.716	0.646	0.551	3.001	0.610	0.627	0.486
Full of life	2.420	0.995	0.677	0.684	2.736	0.918	0.640	0.673	2.771	0.876	0.677	0.626
Close to others	2.575	0.825	0.669	0.603	2.812	0.790	0.676	0.577	2.935	0.745	0.710	0.524
Like you belong	2.923	0.757	0.599	0.615	3.134	0.737	0.540	0.651	3.242	0.682	0.563	0.595
Enthusiastic	2.300	0.914	0.690	0.637	2.645	0.857	0.658	0.629	2.727	0.794	0.728	0.543
Attentive	2.744	0.671	0.613	0.545	2.932	0.688	0.591	0.575	2.948	0.698	0.643	0.541
Proud	2.324	1.006	0.660	0.699	2.597	1.026	0.649	0.714	2.638	1.042	0.711	0.682
Active	2.575	0.788	0.736	0.533	2.811	0.752	0.692	0.541	2.802	0.760	0.697	0.543
Confident	2.835	0.726	0.558	0.629	3.054	0.690	0.512	0.645	3.130	0.644	0.530	0.596

Note. The stem for all items was "How much of the time today did you feel". Intra = intra-individual; Inter = inter-individual.
[a]Indicates age groups were not significantly different.

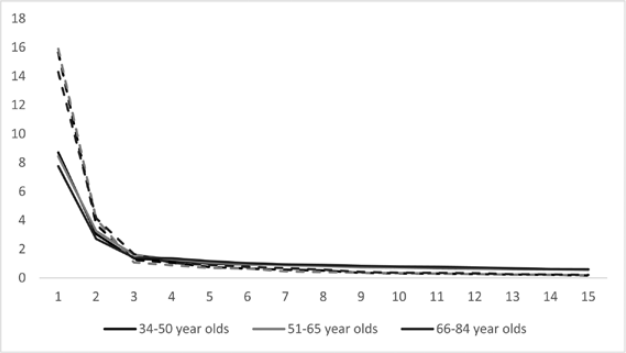

Figure 1. Eigenvalues for inter-individual (solid lines) and intra-individual (dotted lines) factor solutions from MLEFA models.

factor loadings to determine the appropriate model. We first detail model fit for each age group and then describe the extracted factors at the inter- and intra-individual levels.

The 34–50-year-old age group

In the 34–50-year-old group, the eigenvalues and scree plot suggested a two-factor solution at the inter-individual level and a six-factor solution at the intra-individual level. Fit of this model was acceptable, χ^2 (502) = 1765.967, $p < .01$, CFI = .955, TLI = .937, RMSEA = .022, $SRMR_{between}$ = .058, $SRMR_{within}$ = .032. Including more factors (i.e., 3 inter or 7 intra) did not provide better fit when comparing the RMSEA (ΔRMSEA = 0.00) or CFI (ΔCFI = 0.002). Removing factors decreased model fit based on the CFI (ΔCFI = 0.019; ΔRMSEA = 0.003).

The 51–65-year-old age group

Based on the eigenvalues and scree plot, a six factor intra-individual solution and two factor inter-individual solution was examined. This model fit the data well, χ^2 (502) = 1,682.416, $p < .01$, CFI = 0.960, TLI = 0.944, RMSEA = 0.021, $SRMR_{between}$ = 0.048, $SRMR_{within}$ = 0.036. Additional factors at either level did not improve model fit per change in the CFI and RMSEA (ΔCFI = 0.001; ΔRMSEA = 0.000). Removing factors decreased the model fit per the CFI (ΔCFI = 0.02; ΔRMSEA = 0.004).

The 66–84-year-old age group

In this age group, the eigenvalues and scree plot suggested a six factor solution at the intra-individual level and a three factor solution at the inter-individual level. This solution fit the data well, χ^2(477) = 1,247.835, $p < .01$, CFI = 0.957, TLI = 0.937, RMSEA = 0.020, $SRMR_{between}$ = 0.052, $SRMR_{within}$ = 0.038. Additional factors did not improve model fit per the change in CFI and RMSEA (ΔCFI = 0.003, ΔRMSEA = 0.000). Removing factors decreased the model fit based on the CFI (ΔCFI = 0.015; ΔRMSEA = 0.003).

Factor Structure Descriptions

Inter-individual factors

Table 2 displays the factor loadings and correlations for all three groups. Figure 2 illustrates all of the factors for each age group. All positive affect items loaded on a single factor across all three age groups. For the 34–50 and 51–65-year-old age groups, all negative affect items also loaded on a single factor. For the 66–84-year-old group, two factors were required to adequately describe the negative affect items. The first factor included items related to sadness (e.g., *worthless*, *hopeless*) and fear/anxiety (e.g., *restless*, *nervous*). The second factor included the remaining items, which related to anger (e.g., *irritable*, *upset*).

Intra-individual factors

Results for intra-individual factors are discussed first for the negative affect items followed by the positive affect items.

Negative affect.—Factor loadings and correlations for the intra-individual solutions for the negative affect items appear in Table 3 and are illustrated in Figure 3. The 34–50 and 51–65-year-old groups were again similar in that two factors were extracted for negative affect items. The first factor was primarily comprised of items relevant to sadness (*worthless*, *so sad nothing could cheer you up*) and anxiety (*restless*, *jittery*). The second factor was characterized by anger-related items (e.g., *irritable*, *angry*). Two items had cross-loadings on these factors for both groups: *hopeless* and *ashamed*. Interestingly, the item *lonely* did not load significantly in the 34–50-year-old group onto any particular factor. The 66–84-year-old group had three intra-individual factors that included negative affect items. The first factor was defined by sadness-related items (e.g., *so sad nothing could cheer you up*). The next factor included fear and anxiety-related items (e.g., *restless*). The third factor included mostly anger-related items (e.g., *irritable*) with the items from the sadness factor, including loneliness, also significantly cross-loaded on this factor. For this oldest age group, the item *everything was an effort* did not load on any specific factor. As noted above, constraining the sadness factor to be the same as the anger factor led to reduced model fit.

Positive affect.—Factor loadings and correlations for the intra-individual solutions for the positive affect items appear in Table 4 and are illustrated in Figure 3. All groups had a cheerfulness factor represented by in good spirits and cheerful as well as a contentedness factor that included calm/peaceful and satisfied. The 34–50 and 51–65-year-old groups had a separate factors for interpersonally-oriented items (e.g., *close to others*, *like you belong*) and those related to agency (e.g., *proud*, *active*). We identified only one factor in the 66–84-year-old group that included all of these items. The item *extremely happy* did not load on any of the intra-individual factors.

Table 2. Inter-Individual Factor Loadings and Factor Correlations for All Items

	34–50 year olds		51–65 year olds		66–84 year olds		
	Negative affect	Positive affect	Negative affect	Positive affect	Sad/anxious	Angry	Positive affect
Restless	**0.676**	–0.054	**0.779**	–0.028	**0.763**	0.073	–0.032
Nervous	**0.763**	0.007	**0.805**	–0.005	**0.688**	0.248	0.023
Jittery	**0.771**	0.061	**0.854**	0.066	**0.727**	0.243	0.115
Irritable	**0.805**	–0.034	**0.824**	0.003	0.300	**0.685**	0.023
Upset	**0.890**	0.008	**0.877**	–0.022	0.196	**0.817**	–0.036
Angry	**0.847**	0.011	**0.848**	0.019	0.000	**0.912**	–0.010
Frustrated	**0.826**	0.009	**0.760**	–0.085	0.36	**0.598**	–0.082
Afraid	**0.865**	0.072	**0.856**	0.058	**0.611**	0.283	0.001
Worthless	**0.671**	–0.229	**0.781**	–0.064	**0.857**	–0.247	–0.192
So sad	**0.717**	–0.17	**0.871**	0.010	**0.890**	0.012	0.079
Hopeless	**0.810**	–0.178	**0.842**	–0.044	**0.789**	–0.027	–0.201
Lonely	**0.648**	–0.173	**0.769**	–0.016	**0.530**	0.037	–0.239
Ashamed	**0.765**	–0.009	**0.884**	0.182	**0.496**	0.315	–0.011
Everything an effort	**0.682**	–0.038	**0.645**	–0.054	**0.652**	0.021	–0.137
In good spirits	–0.180	**0.786**	–0.116	**0.839**	–0.055	–0.071	**0.820**
Cheerful	–0.111	**0.837**	–0.034	**0.916**	–0.023	–0.065	**0.853**
Extremely happy	–0.017	**0.715**	–0.145	**0.610**	0.025	–0.087	**0.671**
Satisfied	–0.132	**0.840**	–0.103	**0.885**	–0.051	–0.131	**0.845**
Calm and peaceful	–0.204	**0.702**	–0.15	**0.766**	0.003	–0.262	**0.745**
Full of life	0.044	**0.933**	–0.019	**0.903**	–0.070	0.013	**0.826**
Close to others	0.009	**0.829**	0.100	**0.917**	0.124	–0.003	**0.853**
Like you belong	–0.045	**0.830**	0.057	**0.901**	0.112	0.016	**0.872**
Enthusiastic	0.032	**0.911**	–0.002	**0.927**	0.012	0.082	**0.937**
Attentive	0.018	**0.829**	0.050	**0.903**	0.000	0.098	**0.900**
Proud	0.105	**0.863**	0.060	**0.852**	0.163	–0.084	**0.751**
Active	0.000	**0.784**	–0.062	**0.776**	–0.122	0.160	**0.820**
Confident	–0.009	**0.893**	0.022	**0.937**	0.104	–0.008	**0.971**
	Factor correlations						
Sad/anxious	—		—			0.486	
Positive affect	–0.581		–0.599		–0.506	–0.394	

Factor loadings of .40 or greater are bolded.

Discussion

Many studies examine how emotional experience varies across adulthood (e.g., Carstensen et al., 2000), but few studies have examined whether the factor structure of emotional experience is similar with age (e.g., Grühn et al., 2013). Using multi-level factor analyses, we examined the structure that distinguishes people's general emotional experience from each other (inter-individual differences) as well as how emotions cluster together from one day to the next (intra-individual differences) in three adult age groups. We found a slightly greater number of factors capturing negative emotions in older age. In addition, we found several age differences in how emotions were clustered together. Below, we discuss the findings for inter-individual factors for each age group, and then the results for the intra-individual factors. It is important to acknowledge, however, that our interpretation is speculative, given the subjective nature of factor analysis.

The Inter-Individual Factor Structure for Positive and Negative Emotions

In the inter-individual analyses, the same two factors captured all emotions reported for the 34–50 and 51–64-year-old age groups: one including all positive emotions, and another for all negative emotions. This finding is consistent with those from prior studies that have shown a two-factor solution representing negative and positive affect (e.g., Watson, Clark, & Tellegen, 1988). One negative factor is also consistent with a large literature about the personality trait of neuroticism, which is commonly defined by questions asking about anxiety and depressive symptoms, but strongly related to feelings of anger and hostility as well (e.g, Pease & Lewis, 2015). For the oldest age group, one factor also described their positive emotion reports, indicating that people varied from one another on their overall levels of positive affect but not based on any specific type of positive emotional experience. For negative affect, however,

anger emotions loaded onto their own factor, suggesting that older adults varied from one another based on their levels of anger. The other negative emotions—including those related to anxiety and sadness—loaded onto a second factor.

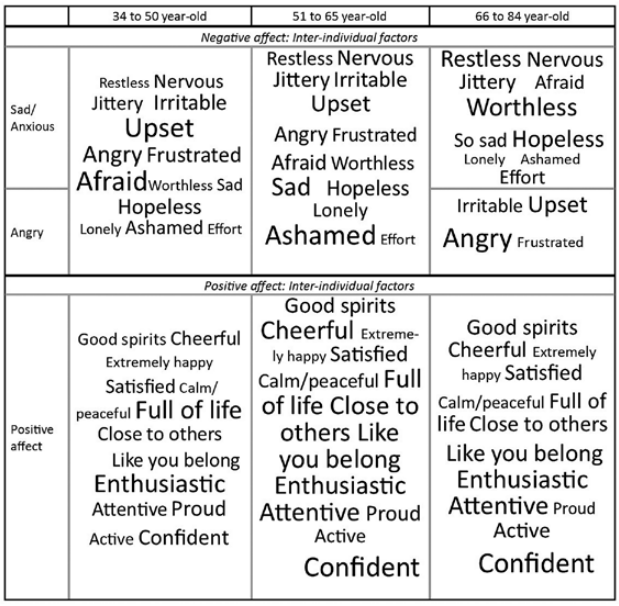

Figure 2. Word clouds representing the content of each inter-individual factor by age group. *Note.* Word presence indicates that the factor loading exceeded the cut off of 0.400 and word size indicates relative strength of the factor loading of each item on the factor. Larger words had the highest loadings. Subsequently smaller words in each factor indicate that at least a 0.05 decrease in factor loading per each decrease in font size. Word size is calibrated so that the item with the highest loading is the same size for the same factors across each age group.

These findings indicate that anger is an important, and distinct, emotional experience for differentiating older adults from one another. When examining age differences in emotions, researchers commonly find that older adults report the lowest levels of anger compared with any other adult age group (e.g., Stone, Schwartz, Broderick, & Deaton, 2010). This common cross-sectional finding offers a tempting argument that anger plays a smaller role in the lives of older adults. Yet, the current findings suggest that even though older adults, as a group, often report lower levels of anger relative to other age groups, anger is more distinct from feelings of anxiety and sadness among older adults compared to their middle-aged counterparts. This finding begs the question of why do older adults vary from one another based on their reports of anger-related emotions as distinct from their levels of other negative emotions?

This study offers no mechanism to explain these patterns, but we offer one speculative interpretation. Based on appraisal theory, anger is related to appraisals of unfairness and are in response to certain outcomes (Frijda, Kuipers, & Ter Schure, 1989). Perhaps oldest adults vary from one another in their sense of injustice regarding their life circumstances, and those dissatisfied in their current situation may feel that this outcome is unlikely to change. For example, people with good retirement benefits and good health may not feel a sense of injustice in their life circumstances, whereas other adults may feel that some aspects of their life—such as having had a job with poor benefits or having a health condition that worsens with age—are not fair. For middle-aged adults, their anger may be directed to situations that are more nuanced, more acute, and as such these situations may be regarded as more uncertain

Table 3. Intra-Individual Factor Loadings for Negative Affect Items

	34–50 year olds		51–65 year olds		66–84 year olds		
	Sad/ Anxious	Angry	Sad/ Anxious	Angry	Sad	Anxious	Angry
Restless	**0.691**	–0.015	**0.677**	–0.016	0.049	**0.645**	0.114
Nervous	**0.749**	–0.001	**0.736**	–0.033	0.005	**0.872**	–0.057
Jittery	**0.733**	–0.045	**0.687**	0.016	–0.074	**0.549**	0.195
Irritable	0.115	**0.581**	0.080	**0.701**	–0.163	0.072	**0.712**
Upset	0.017	**0.852**	0.101	**0.816**	–0.001	–0.013	**0.791**
Angry	–0.204	**0.995**	–0.076	**0.940**	0.019	–0.348	**1.006**
Frustrated	0.052	**0.701**	0.233	**0.584**	0.004	–0.022	**0.746**
Afraid	**0.592**	0.162	**0.746**	–0.005	0.152	**0.359**	0.252
Worthless	**0.475**	0.191	**0.617**	0.074	0.151	0.196	**0.361**
So sad	**0.507**	0.251	**0.449**	0.185	**0.391**	0.147	**0.311**
Hopeless	**0.336**	**0.438**	**0.489**	**0.301**	**0.470**	0.095	**0.407**
Lonely	0.297	0.27	**0.456**	0.062	**0.485**	0.008	**0.308**
Ashamed	**0.304**	**0.418**	**0.414**	**0.330**	–0.081	0.017	**0.565**
Everything an effort	**0.301**	0.169	**0.448**	0.137	0.153	0.171	0.286
	Factor correlations						
Anxious	—		—		0.270		
Angry	0.660		0.590		0.281	0.573	

and therefore elicit a range of negative emotions. This uncertainty may stem from middle-aged adults having a longer future in which to change their current situation, or perhaps to having a higher level of control over their current surroundings.

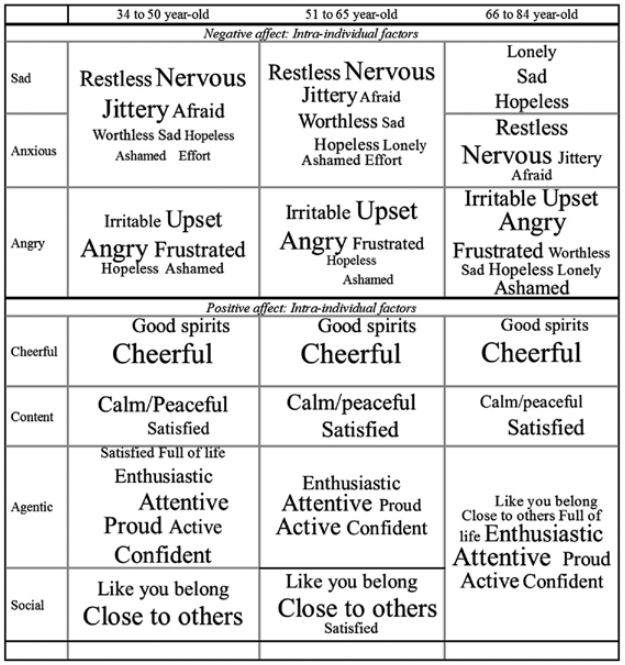

Figure 3. Word clouds representing the content of each intra-individual factor by age group. *Note.* Word presence indicates that the factor loading exceeded the cut-off of 0.300 and word size indicates relative strength of the factor loading of each item on the factor. Larger words had the highest loadings. Subsequently smaller words in each factor indicate that at least a 0.05 decrease in factor loading per each decrease in font size. Word size is calibrated so that the item with the highest loading is the same size for the same factors across each age group.

Age Differences in Intra-Individual Factor Structure for Negative Emotions

In models examining how emotions cluster together at the daily level, the 34–50 and 51–65-year-old age groups had two factors that captured negative emotional experience. These factors corresponded to a fear and sadness factor, and an anger factor. Perhaps these middle-aged adults worry about the future, such as concerns about retirement saving, child-rearing, job insecurity, or new health conditions elicit a mix of both anxiety and some sadness. The variation of sadness and anxiety was unrelated to experiences of anger. Both factors included the emotions of hopeless and shame.

For our oldest group, negative emotions fell into three factors: one for anxiety; one for anger emotions (but sadness emotions were also present); and a third for sadness emotions. The inter-individual factors described above suggested that older adults vary from one another based on their overall levels of sadness/anxiety and their overall levels of anger. At the daily level, however, experiences of anger co-occur with feelings of sadness, including feelings of loneliness, shame, worthlessness and hopelessness. Perhaps anger over one's current situation for older adults is most likely to occur in situations where they feel worthless. For example, they may be angry about circumstances related to poor health or lower levels of prosperity that they feel are unfair, but perhaps these health and economic problems may also elicit feelings of sadness

Table 4. Intra-Individual Factor Loadings and Correlations for Positive Affect Items

	34–50 year olds				51–65 year olds				66–84 year olds		
	Cheerful	Agentic	Social	Content	Cheerful	Agentic	Social	Content	Cheerful	Agentic	Content
In good spirits	**0.582**	0.138	0.002	0.054	**0.608**	0.049	0.053	0.092	**0.601**	–0.007	0.105
Cheerful	**0.928**	–0.006	0.000	–0.020	**0.983**	–0.033	–0.037	–0.037	**0.808**	0.031	0.015
Extremely happy	0.264	0.189	0.055	0.096	0.268	0.113	0.145	0.126	0.234	0.152	0.065
Satisfied	0.161	**0.367**	0.032	**0.371**	0.039	0.164	**0.407**	**0.495**	0.077	0.104	**0.686**
Calm and peaceful	0.069	0.238	0.040	**0.497**	0.131	0.062	0.278	**0.463**	0.156	0.01	**0.490**
Full of life	0.174	**0.384**	0.088	0.186	0.113	0.274	0.286	0.222	0.125	**0.358**	0.276
Close to others	–0.032	0.024	**0.777**	0.044	–0.048	–0.038	**0.789**	–0.051	0.005	**0.340**	0.125
Like you belong	0.042	0.233	**0.455**	–0.008	0.013	0.152	**0.529**	–0.012	0.004	**0.365**	0.182
Enthusiastic	0.105	**0.503**	0.117	0.009	0.088	**0.545**	0.101	0.057	0.074	**0.573**	0.004
Attentive	–0.044	**0.621**	0.023	0.030	0.015	**0.636**	0.007	–0.035	–0.042	**0.628**	0.040
Proud	–0.040	**0.600**	0.028	–0.007	0.003	**0.434**	0.162	0.054	–0.031	**0.461**	–0.015
Active	0.045	**0.521**	–0.033	–0.149	–0.015	**0.633**	–0.090	–0.055	0.075	**0.514**	–0.063
Confident?	0.004	**0.616**	–0.050	–0.022	–0.008	**0.527**	0.093	0.016	–0.011	**0.450**	0.174
	Factor correlations										
Agentic	0.594				0.520				0.509		
Social	0.463	0.585			0.519	0.602			—	—	
Content	0.272	0.097	0.149		0.230	0.111	–0.026		0.435	0.408	

Factor loadings of .30 or higher are bolded.

and worthlessness. The oldest adults also had separate factors for fear and sadness, as opposed to the shared factor observed for the middle-aged groups. Perhaps different events or situations elicit distinct emotions of fear and sadness for these older adults. For example, hearing about the death of a friend or other situations of loss may elicit predominantly sadness, and losses may be more common among this oldest age group. Finally, the term everything was an effort did not load onto any one particular factor, suggesting that this type of experience is not grouped with any particularly type of negative emotional experience.

Age Differences in Intra-Individual Factor Structure for Positive Emotions

The 34–50-year-old and 51–65-year-old age groups had four similar intra-individual factors that captured positive emotions. One factor captured cheerfulness and good spirits; a second captured feelings of calm and peacefulness; a third captured agentic emotions such as feeling confident and active; and a fourth captured interpersonally-oriented emotions of feeling close to others and a sense of belonging. In contrast, the oldest age group had only three intra-individual factors that captured their daily positive emotional experience. Two factors, one comprised of being cheerful and in good spirits and a second capturing feelings of calm and peacefulness, were similar to those observed for the two younger groups. Notably, however, peaceful feelings (calm; satisfied) only loaded onto a single factor for older adults. For the 34–50 year olds, satisfaction loaded on the agentic factor to nearly the same degree, and feeling satisfied loaded on the interpersonal emotion factor for the 51–65 year olds. These findings suggest that feelings of peace and satisfaction may create a more distinct experience for the oldest adults compared to middle-aged adults. Again this is speculative, but perhaps this oldest age group has more situations in daily life where they quietly reflect and experience satisfaction, as opposed to the middle-aged groups who are situations where satisfaction is associated with emotions related to either work (e.g., confident for 35–50 year olds) or social (e.g., close to others among the 51–65 year olds) activities. For all age groups, the item extremely happy did not load onto a specific positive factor. This item also had the lowest mean-level among all the emotion words, and most likely reflects that this emotion is generally not commonly experienced and does not represent the meaningful clusters of positive experience that comprise every day experiences.

The biggest difference between age groups was that agentic and interpersonally-oriented emotions fell on separate factors for the 34–50 and 51–65 year olds, but loaded onto one factor for the older adults. One possible reason for this difference is that the two middle-aged groups may have more work responsibilities that would not necessarily engender positive emotional experiences such as feeling close to others or that they belong. Instead, they may be more likely to feel the emotions that they belong and that they feel close to others with their family and friends outside of the work environment. The 66–84 year olds, in contrast, may have fewer responsibilities that take them away from others for long periods of time. Instead, their positive agentic emotions were increasingly focused in social contexts. This possible explanation is consistent with socioemotional selectivity theory, which posits that social interactions are characterized by more complex positive emotions with age (Carstensen et al., 2000). The older adults in this sample experience their most agentic emotional experiences, such as feeling active and confident, when they are also feeling close with others. This is also consistent with findings showing that older adults reported experiencing more intense and higher levels of positive emotions when they were with family members than did younger adults (Charles & Piazza, 2007).

Limitations

Limitations of this study must be considered along with its contributions. Like many studies of aging, cross-sectional results cannot inform causality. Our findings represent variability associated with age and not developmental changes. Cohort differences may account for age differences in this study; e.g. earlier cohorts may have been socialized to associate anger with sadness more than more recently born cohorts, or feeling close to others with more agentic emotions. Moreover, this study included a specific set of positive and negative emotional states. Although every study is limited by the questions asked, factor analysis is particularly sensitive to item choice. These questions also lacked information about emotional intensity to gauge arousal states. In addition, this sample was predominantly white and middle-class, and a more diverse sample may reveal different age-related patterns. Finally, the meaning of these factors for health and well-being is an open question, and future studies will need to take these factors and study their predictive power.

Future Directions and Conclusion

The current findings offer both practical and theoretical information for the study of emotion and aging. On a practical note, the study suggests that although anger is often reported at lower levels among older adults compared to younger and middle-aged adults, this emotion may be arguably more important when describing how older adults vary from one another in their emotional experiences. Older adults vary from one another on their levels of anger-related emotions, as well as on their overall levels of negative affect. For middle-aged adults, people are differentiated more by overall levels of negative affect, and not be any one type of emotional experience. Regarding how emotions are experienced from day to day, sadness was related more to anxiety for middle-aged adults. For theoretical

development, researchers may benefit from studying reasons behind these different patterns among the different age groups. For example, hopelessness and worthlessness may be more related to fears of the future for middle-aged adults, whereas these emotions may be more likely to be related to anger at one's situation among older adults. In addition, the loading of all interpersonal positive emotions with the more agentic emotions such as feeling proud and confident for the older adults may also point to age differences in the types of situations that elicit these emotions. Together, these results provide directions for what emotions vary with age when understanding emotional experience in daily life, and guide future research on the study of co-occurring emotions in later life.

Funding

This work was supported by National Institute of Aging at the National Institutes of Health by grants R01AG042431 awarded to S.T. Charles and P01 AG020166, R01 AG019239) to D.M. Almeida.

References

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, **107**, 238–246. doi:10.1037/0033-2909.107.2.238

Brose, A., Scheibe, S., & Schmiedek, F. (2013). Life contexts make a difference: Emotional stability in younger and older adults. *Psychology and Aging*, **28**, 148–159. doi:10.1037/a0030047

Browne, M., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

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. doi:10.1037/a0021285

Charles, S. T., & Piazza, J. R. (2007). Memories of social interactions: Age differences in emotional intensity. *Psychology and Aging*, **22**, 300–309. doi:10.1037/0882-7974.22.2.300

Charles, S. T., Piazza, J. R., Mogle, J. A., Urban, E. J., Sliwinski, M. J., & Almeida, D. M. (2016). Age Differences in Emotional Well-Being Vary by Temporal Recall. *The Journals of Gerontology Series B: Psychological sciences and social sciences*, **71**, 798–807. doi:10.1093/geronb/gbv011

Chen, F.F. (2007). Sensitivity of Goodness of Fit Indexes to Lack of Measurement Invariance. *Structural Equation Modeling*, **14**, 464–504. doi:10.1080/10705510701301834

De Leersnyder, J., Boiger, M., & Mesquita, B. (2013). Cultural regulation of emotion: Individual, relational, and structural sources. *Frontiers in Psychology*, **4**, 55. doi:10.3389/fpsyg.2013.00055

Diener, E., Larsen, R. J., Levine, S., & Emmons, R. A. (1985). Intensity and frequency: Dimensions underlying positive and negative affect. *Journal of Personality and Social Psychology*, **48**, 1253–1265. doi:10.1037/0022-3514.48.5.1253

Ersner-Hershfield, H., Mikels, J. A., Sullivan, S. J., & Carstensen, L. L. (2008). Poignancy: Mixed emotional experience in the face of meaningful endings. *Journal of Personality and Social Psychology*, **94**, 158–167. doi:10.1037/0022-3514.94.1.158

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.

Grühn, D., Lumley, M. A., Diehl, M., & Labouvie-Vief, G. (2013). Time-based indicators of emotional complexity: Interrelations and correlates. *Emotion (Washington, D.C.)*, **13**, 226–237. doi:10.1037/a0030363

Hay, E. L., & Diehl, M. (2011). Emotion complexity and emotion regulation across adulthood. *European Journal of Ageing*, **8**, 157–168. doi:10.1007/s10433-011-0191-7

Hox, J. J., Moerbeek, M., & van de Schoot, R. (2010). *Multilevel analysis: Techniques and applications*. Routledge: Quantitative Methodology Series.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, **6**, 1–55. doi:10.1080/10705519909540118

Hülür, G., Hoppmann, C. A., Ram, N., & Gerstorf, D. (2015). Developmental associations between short-term variability and long-term changes: Intraindividual correlation of positive and negative affect in daily life and cognitive aging. *Developmental Psychology*, **51**, 987–997. doi:10.1037/a0039341

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. doi:10.1037/a0015352

Kim, S., Geren, J. L., & Knight, B. G. (2015). Age Differences in the Complexity of Emotion Perception. *Experimental Aging Research*, **41**, 556–571. doi:10.1080/0361073X.2015.1085727

Lawton, M. P., Kleban, M. H., Rajagopal, D., & Dean, J. (1992). Dimensions of affective experience in three age groups. *Psychology and Aging*, **7**, 171–184.

Levenson, R. W., Carstensen, L. L., Friesen, W. V., & Ekman, P. (1991). Emotion, physiology, and expression in old age. *Psychology and Aging*, **6**, 28–35.

Magai, C., Consedine, N. S., Krivoshekova, Y. S., Kudadjie-Gyamfi, E., & McPherson, R. (2006). Emotion experience and expression across the adult life span: Insights from a multimodal assessment study. *Psychology and Aging*, **21**, 303–317. doi:10.1037/0882-7974.21.2.303

Maitland, S. B., Dixon, R. A., Hultsch, D. F., & Hertzog, C. (2001). Well-being as a moving target: Measurement equivalence of the Bradburn Affect Balance Scale. *The Journals of Gerontology B: Psychological Sciences and Social Sciences*, **56**, P69–P77. doi:10.1093/geronb/56.2.P69

Mogle, J., Almeida, D. M., & Stawski, R. S. (2015). Psychometric properties of micro-longitudinal assessments: Between- and within-person reliability, factor structure and discriminate validity of cognitive interference. In M. Diehl, K. Hooker & M. Sliwinski (Eds.), *Handbook of intraindividual variability*. London: Routledge.

Muthén, B. (1984). A general structural equation model with dichotomous, ordered categorical, and continuous latent variable indicators. *Psychometrika*, **49**, 115–132. doi:10.1007/BF02294210

Muthén, B.O. (1994). Multilevel covariance structure analysis. *Sociological Methods & Research*, **22**, 376–398. doi:10.1177/0049124194022003006

Muthén, L. K., & Muthén, B. O. (2007). Mplus. *Statistical analysis with latent variables*. Version, 3.

Pease, C. R., & Lewis, G. J. (2015). Personality links to anger: Evidence for trait interaction and differentiation across expression style. *Personality and Individual Differences*, **74**, 159–164. doi:10.1016/j.paid.2014.10.018

Radler, B. T., & Ryff, C. D. (2010). Who participates? Accounting for longitudinal retention in the MIDUS national study of health and well-being. *Journal of Aging and Health*, **22**, 307–331. doi:10.1177/0898264309358617

Rush, J., & Hofer, S. M. (2014). Differences in within- and between-person factor structure of positive and negative affect: Analysis of two intensive measurement studies using multilevel structural equation modeling. *Psychological Assessment*, **26**, 462–473. doi:10.1037/a0035666

Scheibe, S., English, T., Tsai, J. L., & Carstensen, L. L. (2013). Striving to feel good: Ideal affect, actual affect, and their correspondence across adulthood. *Psychology and Aging*, **28**, 160–171. doi:10.1037/a0030561

Scott, S. B., Ram, N., Smyth, J. M., Almeida, D. M., & Sliwinski, M. J. (2017). Age differences in negative emotional responses to daily stressors depend on time since event. *Developmental Psychology*, **53**, 177–190. doi:10.1037/dev0000257

Stone, A. A., Schwartz, J. E., Broderick, J. E., & Deaton, A. (2010). A snapshot of the age distribution of psychological well-being in the United States. *Proceedings of the National Academy of Sciences*, **107**, 9985–9990. doi:10.1073/pnas.1003744107

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, **54**, 1063–1070. doi:10.1037//0022-3514.54.6.1063

Wirth, R. J., & Edwards, M. C. (2007). Item factor analysis: Current approaches and future directions. *Psychological methods*, **12**, 58–79. doi:10.1037/1082-989X.12.1.58

Wrzus, C., Müller, V., Wagner, G. G., Lindenberger, U., & Riediger, M. (2013). Affective and cardiovascular responding to unpleasant events from adolescence to old age: Complexity of events matters. *Developmental Psychology*, **49**, 384–397. doi:10.1037/a0028325