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Results: Across the adult lifespan, individual differences in personality change were small but significant until old age. For openness, conscientiousness, extraversion, and agreeableness, individual differences in change were most pronounced in emerging adulthood and decreased throughout midlife and old age. For emotional stability, individual differences in change were relatively consistent across the lifespan.

Conclusions: These results inform theories of lifespan development and provide future directions for research on the causes and conditions of personality change.

Keywords: Personality Development, Big Five Personality, Lifespan Development

Individual Differences in Personality Change Across the Adult Lifespan

A precise and comprehensive description of lifespan personality development is critically important to personality psychology. As researchers deepen their understanding of normative lifespan personality development, they are able to make more specific and detailed theoretical inferences about when, why, and how personality changes or remains stable. Much research has focused on the average trajectory of personality traits across the lifespan (e.g. Roberts & DelVecchio, 2000; Roberts, Walton, & Viechtbauer, 2006). For example, a large body of research has shown that mean-levels of emotional stability increase throughout adulthood (Lucas & Donnellan, 2011; Terracciano, McCrae, Brant, & Costa, 2005; Wortman, Lucas, & Donnellan, 2012; for a meta-analysis, see Roberts, Walton, & Viechtbauer, 2006). However, at each stage of life, a substantial number of people may deviate from this mean-level trajectory. While most young adults increase slightly in emotional stability, a substantial number may become drastically more emotionally stable, or may decrease in emotional stability. To fully describe lifespan personality development, one must quantify these individual differences in change at each stage of life (Nesselroade, 1991; Roberts, Wood, & Caspi, 2008).While there is some evidence for individual differences in personality change at different ages (e.g. Allemand, Zimpritch, & Hertzog, 2007; Bleidorn, Kandler, Riemann, Angleitner, & Spinath 2009; Mroczek & Spiro, 2003; Roberts, Caspi, & Moffitt, 2001; Robins, Fraley, Roberts, & Trzesniewski, 2001; Schwaba et al., 2016; Terracciano et al., 2005), a comprehensive examination of the degree to which individuals differ in their personality trajectories across the adult lifespan has yet to be done.

Such an examination is needed to guide targeted examinations into the conditions and determinants of personality change at specific ages and across different trait domains. For

example, individual differences in emotional stability development may be relatively prominent in emerging adulthood but may wane across the lifespan. Such a finding would spur investigations into environmental or genetic factors responsible for heterogeneity in change among the young and homogeneity in change among the old. In this way, a precise and comprehensive description of personality development across the lifespan begets an improved explanation of personality development across the lifespan.

In this study, we aim to provide a map of individual differences in personality change across the adult lifespan. We examine the degree to which individuals' Big Five personality trajectories differ from each other throughout the adult lifespan (ages 16-84 at initial measurement) using data from a large nationally representative longitudinal study. Two questions guided this analysis. First, when in the life course are individual differences in personality change most and least prominent? Second, do individual differences in personality change vary across different trait domains?

Comparisons Between Different Types of Change Across the Lifespan

There are multiple ways to describe personality change across the lifespan. According to Roberts et al. (2008), change can be measured at the population level or at the individual level, and in terms of absolute change or relative change. In this section, we briefly define and review personality mean-level (population, absolute) and rank-order (population, relative) change and contrast these types of change with individual differences in change (individual, absolute). The fourth type of change, ipsative change (individual, relative), has been studied less often. We will not cover it in depth here (for research addressing ipsative personality change, see Bleidorn, Kandler, Riemann, Angleitner, & Spinath, 2012; Furr, 2008; Klimstra et al., 2009).

Mean-Level Change

Mean-level change reflects the degree to which a population increases or decreases in a personality trait over time, often quantified as a standardized mean difference between two time points (e.g., Cohen's d). A large body of longitudinal research on mean-level personality change has shown that most people tend to increase in conscientiousness, agreeableness, and emotional stability as they age, especially during early adulthood. In contrast, mean levels of extraversion tend to remain relatively stable across adulthood, while mean levels of openness tend to decrease over the course of adulthood (Lucas & Donnellan, 2011; Terracciano et al., 2005; Wortman et al., 2012; for reviews, see Bleidorn & Hopwood, 2016; Specht et al., 2014; Roberts, et al., 2006).

Mean-level change and individual differences in change are statistically independent of each other (Nesselroade, 1991). To illustrate this, the left half of Figure 1 shows a hypothetical sample of three people assessed at two time points. In this example, there may be mean-level change with (1a) or without (1e) individual differences in change, individual differences in change without mean-level change (1b), or neither type of change (1f). To fully describe absolute personality development across the lifespan, it is thus necessary to have information about both mean-level change (the average trend) and individual differences in change (the variation around this trend), because both contribute unique information about the nature, shape, and possible mechanisms of personality trait change. [Insert Figure 1 here]

Rank-Order Change

The second type of population-level change, rank-order change, refers to the relative ordering of individuals in a population over time, commonly quantified as test-retest correlation (r) across two assessment waves. Research has repeatedly demonstrated that rank-order change in personality traits decreases throughout early and middle adulthood, reaches its nadir in midlife, and increases again in old age and very old age (Ardelt, 2000; Bleidorn & Hopwood,

2016; Briley & Tucker-Drob, 2014; Lucas & Donnellan, 2011; Roberts & Del Vecchio, 2000; Wortman et al., 2012). A more general finding to emerge from this research is that, throughout the lifespan, the maximum rank-order stability estimates for personality stability range between .70 and .80, leaving room for change in individual trajectories that affects rank ordering over time. This finding provides strong evidence for a lifelong plasticity of personality traits.

Rank-order change and individual differences in change are not statistically independent of each other. In the presence of rank-order change, there must be individual differences in change to some extent [Figure 1]. The finding that rank-order stability never reaches unity throughout the lifespan thus implies that there are individual differences in personality change throughout the lifespan. However, rank-order change is an ordinal index of change that indicates the *relative* ordering of individuals on a personality trait. It quantifies developmental heterogeneity less precisely than a measure of individual differences in change, which reflects the *absolute* change in a trait. Figure 1d shows a hypothetical example where rank-order measurement does not identify that people are developing differently from one another because there is no relative change, even though there are individual differences in change. An analysis of individual differences in personality change across the lifespan is necessary to index the actual amount of heterogeneity in development because it reflects absolute rather than relative change.

Previous Analyses of Individual Differences in Development Across the Lifespan

Although no study to date has analyzed individual differences in personality change across the lifespan, several longitudinal studies have examined individual differences in change in different age groups using different operationalizations of individual differences in change. Early studies utilized the Reliable Change Index (RCI), adapted from the clinical personality literature, to measure individual differences in change. The RCI indexes whether a participant's

trait score changed by two or more standard errors to identify whether change was meaningful or potentially due to measurement error (Roberts & Mroczek, 2008; Roberts et al., 2001; Robins et al., 2001). However, meaningful personality trait change may be rather small in magnitude and fail to reach the two standard error cutoff, so the RCI may underreport individual differences in personality change. Nevertheless, all previous studies that have employed the RCI have found individual differences in personality change beyond the RCI's two-standard-error cutoff (De Fruyt et al., 2006; Roberts & Mroczek, 2008; Roberts et al., 2001; Robins et al., 2001). These studies, most of which studied samples of young adults, have provided evidence for substantial individual differences in personality development.

A second methodologically superior method to establish individual differences in change is latent growth curve (LGC) modeling (Roberts & Mroczek, 2008). LGC models quantify individual differences in change on a continuous scale rather than sorting participants into discrete *change* vs *no-change* groups. They also allow to account for uncertainty in the measurement of change across multiple measurement occasions and thus provide more reliable estimates of individual differences in change than the RCI (e.g. Allemand, Zimpritch, & Hertzog, 2007; Bleidorn et al., 2009; Hopwood et al., 2011; Lüdtke, Trautwein, Roberts, & Nagy, 2011; Mroczek & Spiro, 2004; Scollon & Diener, 2006; Small, Hertzog, Hultsch, & Dixon, 2003),

To the best of our knowledge, no study to date has used LGC modeling to estimate the extent to which individuals differ in their Big Five personality trajectories across the lifespan. Two studies that we know of have compared individual differences in personality change across multiple age groups. Allemand and colleagues (2007) used a LGC model approach to examine individual differences in Big Five trait change across two time points in a middle-aged cohort (ages 42-46) and a cohort of older adults (ages 60-64). Across the two cohorts, they found that

older adults exhibited greater individual differences in openness change and lesser individual differences in neuroticism change. Across traits, they found that individual differences in agreeableness change were greater in magnitude than individual differences in change in the other four traits

Schwaba and colleagues (2017) compared individual differences in openness change across a young cohort (ages 16-26), middle-aged cohort (age 27-64), and older cohort (ages 64-95), estimating LGC models using the same dataset that we use in this study[1]. They found significantly fewer individual differences in openness change in the older cohort compared to the two younger age groups. However, they did not investigate individual differences in change for the other four Big Five traits, and they categorized participants into three relatively broad age groups, reducing temporal precision. Nevertheless, these findings and the large body of evidence for varying degrees of rank-order change across the lifespan suggest that individual differences in personality change across the lifespan may vary with age and across different trait domains.

Lifespan Trends in Individual Differences in Personality Change

While we have no strong predictions about the ages at which individual differences in personality change may be most and least prominent, theories of lifespan development suggest that individual differences in personality change may vary across different life stages (Arnett, 2000; 2007; Baltes; 1997; Bleidorn & Hopwood, 2016; Bleidorn & Schwaba, 2016; McAdams & Olson, 2010; Neugarten, 1968; Roberts & Davis, 2016; Roberts et al., 2005; Roberts et al., 2008). We refer to these theories to generate exploratory hypotheses concerning the degree to which there will be individual differences in personality change across emerging adulthood, young and middle adulthood, and old age.

[1] While Schwaba and colleagues (2016) and this study both use LISS panel data, this study includes a greater number of LISS participants and conducts different analyses than the aforementioned study.

Much research has focused on emerging adulthood (Arnett, 2000) as a critical period for personality development (for recent reviews, see Bleidorn, 2015; Bleidorn & Hopwood, 2016; Bleidorn & Schwaba, 2016; Roberts & Davis, 2016). Emerging adulthood is a life stage between adolescence and full-fledged adulthood that describes people between 18-30 years old who do typically not have children, do not live in their own home, or do not have sufficient income to become fully independent (Arnett, 2000). Both rank-order and mean-level change are particularly pronounced in emerging adulthood (Robins et al., 2001; Roberts & Del Vecchio, 2000; Roberts et al., 2005; Roberts et al., 2006). Theory and research suggests that this life stage might also be a time of substantial individual differences in personality change because emerging adults, more than any other age group, vary in the timing and content of their life experiences. According to Jeffrey Arnett, "emerging adulthood is the most volitional period of life, the time when people are most likely to be free to follow their own interests and desires, and those interests and desires lead them in an exceptionally wide range of directions" (2006, p. 15). Because emerging adults vary so much in life experiences, some of which may affect personality development (Bleidorn, Hopwood, & Lucas, 2016; Specht et al., 2011; Lüdtke et al., 2011), emerging adults may change more heterogeneously relative to one another than middle-aged or older adults. Hence, we predict that emerging adulthood may be characterized by prominent individual differences in personality change in all Big Five traits.

In young and middle adulthood (Which we define as ages 30-64), there may be fewer individual differences in personality trait change. Whereas emerging adulthood is characterized by a freedom to explore different lifestyles and worldviews, young and middle adulthood are characterized by commitments to normative social roles in the domains of family and work (Arnett, 2000; 2006; Rindfuss, 1991; Roberts et al., 2005). This overall emphasis on commitment

to social roles and maintenance of established life styles suggests that personality trait development in young and middle adulthood should be characterized by high degrees of stability. Even if confronted with environmental changes, increased levels of self-awareness, identity commitment, and a wide array of coping strategies that are characteristic to this life stage (Neugarten, 1968; Roberts et al., 2008), may buffer young and middle aged adults against environmental stressors that would otherwise trigger personality change (Bleidorn & Hopwood, 2016). Consistent with the description of young and middle adulthood as a period of consistency, there is strong evidence that the rank-order stability of personality traits peaks during this life stage. Meta-analytic findings suggest that the rank-order stability of personality traits increases in a monotonic fashion throughout middle adulthood and plateaus around age 50 (Briley & Tucker-Drob, 2014; Roberts & DelVecchio, 2000). This finding holds for both men and women and across different Big Five domains. Consequently, based on the robust evidence that young and middle adulthood are characterized by relative stability in identity and environment, we predict that individual differences in personality change will be relatively less pronounced during this life stage.

In late life, people undergo a wide variety of experiences associated with the aging process, and these diverse experiences may once again promote individual differences in personality change. Gerontological studies on aging have found that individuals differ substantially with respect to physical and cognitive declines. While the general trend is towards decreases in strength and perceptual speed (Mueller et al., 2016; Penninx, Deeg, van Eijk, Beekman, & Guralnik, 2001), gradually accumulating chronic disease (Sutin, Zonderman, Ferruci, & Terracciano, 2013), and cognitive decline (Salthouse, 2012), there is substantial variability in these aging processes. Individuals also differ in social changes that come with age.

Aging adults tend to differ in the timing and degree to which they disengage from social roles as they lose relationships as their partners, loved ones, and friends move or pass away (Bleidorn & Hopwood, 2016; Wrzus, Hanel, Wagner, & Neyer, 2013). There is also significant heterogeneity surrounding retirement: people retire at different ages and into different social environments (e.g. retirement homes, independent living, living with family). If these physical, cognitive, and social changes impact personality trait change in old age (Mueller et al., 2016; Sutin et al., 2013; Löckenhoff et al., 2009; Specht et al., 2011), individual differences in physical, cognitive, and social development may spur individual differences in personality development during this life stage. Consistent with this notion, past research has found that the rank-order stability of personality decreases in old age (Briley & Tucker-Drob, 2014; Specht et al., 2011; Wortman et al., 2012). Thus, we hypothesize increasing individual differences in personality change in older age groups.

Trait-specific Patterns in Individual Differences in Personality Change

Although we had no strong hypotheses about how individual differences in personality change may vary across traits, theory and previous research on personality development suggests that individual differences in emotional stability, conscientiousness, and agreeableness development may follow a more similar developmental trajectory compared to individual differences in openness and extraversion development. At a superordinate level, the Big Five traits tend to cluster into these two groups (DeYoung, 2006; Digman, 1997), and research has demonstrated that changes among the traits within each of these clusters are correlated (Klimstra, Bleidorn, Asendorpf, van Aken, & Denissen, 2013). This clustering may extend to individual differences in personality change such that there are two general patterns of individual differences in change across the lifespan. Individual differences in emotional stability, agreeableness, and

conscientiousness change may follow one pattern, possibly due to individual differences in commitment to adult roles and serotonergic functioning (DeYoung & Gray, 2009; Roberts et al., 2005), while individual differences in openness and extraversion change may follow a separate pattern, possibly due to individual differences in exploratory behavior and dopaminergic functioning (DeYoung & Gray, 2009; Schwaba et al., 2017). The findings of Allemand and colleagues (2007) partially support this hypothesis. They found that, in middle-aged adults, individual differences in change were greatest for the traits of emotional stability, conscientiousness, and agreeableness. In this study, we examined whether this pattern held across adulthood.

The Present Study

To supplement mean-level and rank-order descriptions of personality change, and to guide future research on the causes and conditions of personality change, we investigated individual differences in Big Five personality change across the adult lifespan using a large (N = 9,636), five-wave longitudinal sample representative of the population of the Netherlands. To examine individual differences in change in different age groups, we first divided the sample into 14 different groups. Next, we established measurement invariance across assessment waves and across age groups for each Big Five trait domain. We then estimated a multi-group LGC model for each Big Five trait in each of the 14 age groups across the study period to quantify individual differences in personality change across the adult lifespan.

Methods

Participants

Data for this study came from the Longitudinal Internet Studies for the Social Sciences (LISS) panel, which has followed a representative sample of the Dutch population from 2008 to

2014 (Scherpenzeel, Das, Ester, & Kaczmirek, 2010). We used data from all LISS participants in the 2008, 2010, and 2012 cohorts who completed the personality survey (total N = 9,636; 2008 cohort N = 6,949; 2010 cohort N = 1,463; 2012 cohort N = 1,224). The 2008 cohort completed personality surveys in 2008, 2009, 2011, 2013, and 2014. The 2010 cohort completed personality surveys in 2010, 2011, 2013, and 2014. The 2012 cohort completed personality surveys in 2012, 2013, and 2014. Information about how many people from each cohort took the survey each year is available in the supplementary materials (Table S1). We omitted the 2014 LISS cohort from this study because these participants only completed only one wave of personality data.

We grouped participants into five-year age clusters by their age at the first measurement occasion (16-19 N = 809; 20-24 N = 509; 25-29 N = 623; 30-34 N = 751; 35-39 N = 882; 40-44 N = 895; 45-49 N = 968; 50-54 N = 894; 55-59 N = 936; 60-64 N = 892; 65-69 N = 670; 70-74 N = 402; 75-79 N = 272; 80-84 N = 133; 85-89 N = 37; 90-95 N = 7). We then excluded the two oldest age groups from all analyses due to their very small sample sizes, leaving 14 age groups. Our final sample of 9,636 participants ranged from ages 16-84 at the first measurement occasion (M = 49.94, SD = 16.98). For more information on LISS panel characteristics, see Scherpenzeel and colleagues (2010).

Measures

The Big Five personality traits were assessed with the 50-item IPIP version of the Big-Five inventory (Goldberg, 1992). Responses were measured on a five-point Likert scale ranging from 1 (*very inaccurate*) to 5 (*very accurate*). Cronbach's alpha for each scale ranged from .76 to .89 across each of the seven years of the study, and from .72 to .89 across each of the 14 age groups, indicating acceptable inter-item reliability (An exception to the otherwise acceptable alpha reliabilities is the reliability for agreeableness in the 80-84 age group, which was .65).

Means, standard deviations, and alpha reliabilities for each of the Big Five, both by year and by age group are available in the supplemental materials (Tables S2 and S3). We transformed the raw scale scores into standard *T*-scores by standardizing across all participants across all waves to a mean of 50 and a standard deviation of 10. *T*-scores can be used to index effect sizes: a difference of 2 T-score points represents a small effect, a difference of 5 points represents a medium effect, and a difference of 8 points represents a large effect.

Results

Measurement Invariance

We established that the Big Five personality scales were comparable across the adult lifespan and across assessment waves using the lavaan package version 0.5-18 in R version 3.3.1 (Rosseel, 2012; R Core Team, 2013). We handled missing data using Full Information Maximum Likelihood (FIML) estimation, which estimates models using all available responses from all participants.

First, we tested measurement invariance across the adult lifespan. To do so, we sorted participants into 14 age groups. We estimated each participant's personality at first measurement occasion at the latent level using the ten items per scale as indicators. Because the Big Five are multifaceted constructs, some items correlated over and above their relation to the latent personality factor. To account for this, we allowed for correlated residuals between the 15 items that most improved initial χ^2 model fit. We then tested, sequentially, whether it was possible to constrain factor loadings and item intercepts to be equal across age groups without a significant decrease in Confirmatory Fit Index (CFI) or Root Mean Square Error Approximation (RMSEA; Vandenberg & Lance, 2000). Results of these tests indicated that factor loadings could be constrained across the lifespan for each Big Five trait without a significant decrease in model fit

(all ΔCFI $\leq$ .005; all ΔRMSEA = .000; cf. Cheung & Rensvold, 2002). However, constraining item intercepts to be equal across the lifespan led to significant decreases in model fit for each Big Five Trait (all ΔCFI $\geq$ .011; all ΔRMSEA $\geq$ .012). An exception to this pattern is the RMSEA for emotional stability, which increased by only .003. Results of these tests thus establish weak measurement invariance. Across age groups, items had similar associations with the latent personality construct they were designed to measure. Some scale items are differentially endorsed by different age groups. Notably, this finding does not preclude between-group comparisons (e.g. endorsement of the item "am the life of the party" is positively associated with the latent construct of extraversion for both older and younger adults, although older adults are less likely to endorse the item on average; Vandenberg & Lance, 2000).

Second, we conducted measurement invariance tests across the five assessment waves. To do so, we collapsed participants across age groups and constrained, sequentially, model configuration, factor loadings, and item intercepts to be equal within participants across the waves of the study. Results of these tests indicated strong measurement invariance: factor loadings and item intercepts could be constrained across assessment waves in each LISS cohort for each Big Five trait without a significant decrease in model fit (all ΔCFI $\leq$ .004; all ΔRMSEA $\leq$ .001; cf. Cheung & Rensvold, 2002).

Overall, results of these tests indicate that we can meaningfully compare individual differences in Big Five personality change across age groups (Vandenberg & Lance, 2000; Cheung & Rensvold, 2002). Complete results of measurement invariance tests are available in the supplementary materials (Table S4). R scripts for these tests are available at osf.io/t3yjn.

Multiple-Group Latent Growth Curve Models

After we established measurement invariance across age groups and within participants, we measured individual differences in personality development across the adult lifespan through estimating a series of LGC models. We performed these analyses in Mplus version 7.31 (Muthen & Muthen, 2010) using FIML estimation.

As before, we divided participants into 14 age groups, each encompassing five years, based on their age at first measurement occasion (ages 16-84). We then estimated a multiple-groups linear LGC model across the seven waves of the study for each Big Five trait. Specifically, we estimated how the personality traits of each individual developed across the five assessment waves of the study by estimating two latent factors from observed[2] trait scores: an intercept factor that estimates participants' personality scores at the initial measurement occasion, and a slope factor that estimates the linear change in trait score per year across all seven measurement occasions. In these models, the variance parameter of the latent slope factor quantifies between-person heterogeneity in linear personality change over the study period. We use this parameter to estimate the amount of individual differences in personality change (Duncan, Duncan, & Strycker, 2013; cf. Scollon & Diener, 2006). An illustration of this latent growth curve model is available in the supplementary materials (Figure S1). Mplus output files are available at osf.io/t3yjn.

For each trait, the multiple-group linear latent growth curve model fit the data well (CFIs $\geq .991$, RMSEAs $\leq .027$, 95%CIs, $\chi^2(325) \leq 486.19$, $p < .001$). Due to missing data patterns within the age 75-79 age group, the observed covariance matrix for conscientiousness did not converge, but the estimated covariance matrix did converge and was interpretable. As such, only

[2] In these LGC models, we measured yearly trait scores by calculating the mean of all items rather than through estimation of a latent variable. While estimating a growth curve model from latent variables (i.e. a second-order LGC) eliminates random error in score estimation, these models did not converge and thus could not be estimated. This nonconvergence may have been caused by the patterns of planned missingness created by the three-cohort nature of the data.

AIC and BIC fit statistics were available for this model. The AIC and BIC for this model were similar to the models for the other four traits, indicating that the conscientiousness model also fit the data well. More detailed results of model fit are available in the supplementary materials (Table S5). To facilitate interpretation, we fixed slope variance parameters with negative point estimates to zero. We present the slope variance parameters, indicating individual differences in personality change, for each age group and each Big Five trait in Table 1. We present a visualization of these results in Figure 2. Complete parameter estimates from all LGC models are available in the supplementary materials (Table S6)[3]. [Insert Table 1 and Figure 2 here]

LGC model results indicated significant individual differences in personality change across most of the lifespan for each Big Five trait. Specifically, for each trait, the slope variance parameter was significant in all age groups but the oldest age groups. Individual differences in trait development were no longer significant for conscientiousness after age 75, for openness after age 70, for agreeableness after age 65, and for extraversion from ages 70-74. This result may partially be attributable to smaller sample sizes among the oldest age groups.

Four of the Big Five traits followed a highly similar pattern of individual differences in change across the adult lifespan: individual differences in change were most prominent in emerging adulthood, somewhat prominent across young and middle adulthood, and least prominent in old age. Specifically, for openness, conscientiousness, extraversion, and agreeableness, point estimates for the slope variance parameters in the three youngest age groups

[3] Results of LGC models presented in Table S6 also describe mean-level personality development across the lifespan. Overall, the observed mean-level change parameters were highly similar to those of other large-scale panel studies of mean-level personality development across the lifespan (Lucas & Donnellan, 2011; Specht et al., 2011; Terracciano et al., 2005; Wortman et al., 2012). Specifically, we found mean-level decreases in openness across adulthood (see also Schwaba et al., 2017) and increases in conscientiousness across adulthood. Agreeableness increased in early adulthood and remained largely stable afterwards. Extraversion and emotional stability remained largely stable across adulthood.

(ages at initial measurement 16-29) ranged from about 1.6 T-scores per year for agreeableness to about 0.9 T-scores per year for openness. This indicates that there is small but significant variance around the mean trajectory; participants' change in personality tended to vary 0.9 to 1.6 tenths of a standard deviation per year around the average change in personality for their age group and trait. In young and middle adulthood, (ages at initial measurement 30-64), slope variance point estimates were approximately 0.5 T-scores per year for each of these four traits. In late life (ages at initial measurement 65-84), point estimates for slope variance decreased, ranging from 0.4 T-scores per year for extraversion to about 0.1 T-scores per year for agreeableness.

Emotional stability followed a different pattern of individual differences in change across the lifespan than the other four Big Five traits. The individual differences in this trait remained relatively constant throughout the adult lifespan. Across age groups, the point estimate for the emotional stability slope variance factor was about 0.75 T-scores per year. This indicates that participants' absolute change in emotional stability tended to vary 0.75 tenths of a standard deviation per year around the average change in emotional stability for their age group.

Discussion

This study is the first to quantify individual differences in personality change across the adult lifespan. We found small but significant individual differences in Big Five personality change across most of adulthood. For openness, conscientiousness, extraversion, and agreeableness, individual differences in change were greatest in magnitude in emerging adulthood, lesser in magnitude in young and middle adulthood, and smallest in magnitude in old age. For emotional stability, individual differences in change were generally small and remained relatively constant across adulthood.

At any age and for each trait, some people's personality trajectories deviate from the average population trajectory, indicating that personality development is never completely homogenous across the population. This finding is consistent with past research on rank-order personality change across the lifespan (Briley & Tucker-Drob, 2014; Ferguson, 2010; Lucas & Donnellan, 2011; Roberts & DelVecchio, 2000; Wortman et al., 2012) and major theories of development that posit lifelong plasticity of personality traits (Baltes, 1997; Roberts et al., 2005; Roberts et al., 2008). The present finding of substantial individual differences in personality change is important for future research that seeks to explain the conditions of personality development in different life stages. We next discuss the observed age trends in individual differences in Big Five personality change and their implications for theory and future research on personality change.

Individual Differences in Personality Change Across the Life Span

In emerging adulthood, individual differences in personality change were greatest in magnitude. This finding provides further evidence that emerging adulthood is a critical period for personality development. Not only is emerging adulthood a time when mean-level and rank-order change is particularly prominent (Bleidorn & Hopwood, 2016; Bleidorn & Schwaba, 2016; Roberts et al., 2006; Roberts & Davis, 2016), but it is also the age where individuals tend to deviate the most from the average developmental trajectory. These prominent individual differences in change may be partly attributable to the heterogeneity in experiences characteristic to emerging adulthood. Some 20-somethings, but not all, attend college, get married, start their careers, move residences, and engage in identity exploration (Arnett, 2006; Rindfuss, 1991), and each of these experiences may catalyze personality change (Hutteman, Hennecke, Orth, Reitz, & Specht, 2014; Lüdtke et al., 2011). With so much variation in the nature and timing of major life

experiences it is perhaps not surprising that individual differences in personality change are greatest during this stage of life.

In young and middle adulthood, individual differences in personality change were less pronounced than in emerging adulthood, although they were still statistically significant. That is, people were changing more similarly to each other during this life stage than in emerging adulthood. One potential explanation for this finding is that people in midlife have the ability to create stability. Whereas emerging adults may be exploring various environments and life paths, and older adults may be struggling against the inevitability of physical and mental decline, those in midlife may generally be in a position where maintaining a stable environment (i.e. working a steady job, raising children in one place) is both desirable and possible, limiting the environment's potentiality to affect personality in different ways across people (Roberts et al., 2008).

In old age, individual differences in personality change were smallest in magnitude, and often not statistically significant. In this sample, older adults developed relatively homogenously relatively to one another, despite past research and theory that has suggested that old age may be a time of prominent individual differences in personality change (e.g. Briley & Tucker-Drob, 2014; Roberts & DelVecchio, 2000; Specht et al., 2014; Wrzus, Hanel, Wagner, & Neyer, 2013).

There are many potential explanations for this counterintuitive finding. Older adults may have relatively little freedom to exhibit individual differences in behaviors due to physical, social and financial limitations, which may limit the potential for individual differences in change. Rather, the strongest influences on personality may be more universally experienced across older adults, reducing individual differences in change. Another explanation for this finding may be that older adults have developed compensatory mechanisms (Baltes, 1997) that may buffer them

against the influence of potential environmental stressors in old age. Drastic individual differences in physical and mental decline (e.g. Mueller et al., 2016; Penninx et al., 2001; Salthouse, 2012; Sutin et al., 2013) may translate into only small individual differences in personality change if they are first filtered through well-established identities (Roberts et al., 2008).

Finally, this finding may be due to increased attrition among older adults who experienced drastic declines in functioning. If this is true, the present research may have been unable to measure individual differences in personality change amongst older adults. This concern is alleviated somewhat by the nature of the sample we used. The LISS panel has collected additional participant cohorts to balance out attrition effects and maintain representativeness of the Dutch population.

Reconciling Rank Order Change and Individual Differences in Change

Because rank-order change is not statistically independent of individual differences in change [Figure 1], it is important to reconcile the findings of the present study with past research on rank-order change across the lifespan. The present results of individual differences in personality change in emerging, young, and middle adulthood are consistent with previous research on rank-order change. Both, individual differences in change and rank-order change appear to decrease throughout these stages of life (Ardelt, 2000; Roberts & DelVecchio, 2000; Briley & Tucker-Drob, 2014; Ferguson, 2010; Lucas & Donnellan, 2011; Specht et al., 2011; Wortman et al., 2012). However, results of this study diverged from past research on rank-order change in old age. While each of the aforementioned studies (except Ferguson, 2010) found increases in rank-order change in old age, the present results suggested that individual differences in change decrease throughout old age.

To better understand the association between these two types of change within the present dataset, we also analyzed the annual rank-order change in each Big Five trait across the adult lifespan using the data from the LISS panel. These analyses indicated that, in this sample, annual rank-order change estimates did not increase in old age (see Figure S2 in the supplemental materials). This suggests that our results of rank-order and individual differences in change are internally consistent, but these results are inconsistent with previous studies of rank-order change in old age. A potential explanation for these findings is differences in measurement intervals. In the LISS panel, personality was measured at yearly intervals. In contrast, in most previous studies of rank-order change, the interval between personality assessments typically ranged between 4 and 6 years (Bleidorn et al., 2016; Luhmann, Orth, Specht, Kandler, & Lucas, 2014). The test-retest reliability of personality measures decreases as time between measurement occasions increases (Fraley & Roberts, 2005). As such, it could be that differences in the longitudinal design have led to discrepancies between this study's findings on individual differences in change in late life and other studies' findings on rank-order change in late life.

Emotional Stability: Consistent Individual Differences in Change Across the Lifespan

The trends discussed above apply to four of the Big Five traits, but individual differences in emotional stability change across the adult lifespan followed a different trend. For this trait, individual differences in change were relatively stable throughout adulthood. Features unique to emotional stability may help explain this finding. In particular, traits differ in their behavioral, affective, and cognitive content; emotional stability, more than the other Big Five traits, is associated with affect (Wilt & Revelle, 2015). Stability and change in emotional stability may thus be more contingent on affective experience and less contingent on behavioral or cognitive experience (Bleidorn et al., 2016).

Consistent individual differences in emotional stability development across the lifespan may be attributable to variability in affective experience across the lifespan. With age, people typically become more committed to normative social roles in the domains of family and work, which may constrain their behavioral and cognitive experiences. Affective experience, however, may be less constrained by these normative social commitments. That is, while most people master the transition into adult social roles, which may result in mean-level increases in emotional stability (Bleidorn & Denissen, in press; Roberts et al., 2005), there may also be marked deviations from these trends for people who struggle with the challenge of these new roles. For some, parenthood may be rewarding (and lead to increased emotional stability), while for others it may be a source of constant stress (and lead to decreased emotional stability). Moreover, variability in affective experience is not confined to early adulthood. Throughout their lives, people are constantly striving to complete developmental tasks (Erikson, 1959). Lifelong individual differences in affective experience, as well as responses to these experiences (e.g. going to therapy, Roberts et al., 2017) may partially explain why we found persistent individual differences in emotional stability change across the lifespan. Unfortunately, there is little empirical evidence in favor of or against this proposition because few studies to date have examined individual differences in personality change following life events (e.g. Bleidorn et al., 2016; Scollon & Diener, 2006).

Limitations and Future Directions

In this study, we quantified individual differences in personality development in a representative sample of the Dutch population across five assessments between 2008 and 2014. One must exercise caution when generalizing these results to other time periods or populations. Our findings on emerging adulthood may be particularly difficult to generalize to other non-

Western cultures or cohorts. If this life stage is indeed a product of recent social developments and is relatively contained to affluent, Western, industrialized nations (Arnett, 2000; 2006), past cohorts of 16-29-year-olds and young adults in developing nations may exhibit fewer individual differences in personality change than we observed in this study. Additionally, this study measured personality traits by self-report, which may be prone to biases that distort estimates of personality change. Future studies would be needed to test whether the observed patterns replicate using other methods of personality assessment, such as peer report or behavioral observation.

A central motivation behind this study was its utility to future research. Understanding the ages and traits for which individual differences in change are most and least prevalent can help researchers design targeted studies to understand the conditions and mechanisms behind trait change at specific ages. Broadly, the results of this study suggest that there is much between-person variability in personality change to be explained in emerging adulthood. Past research has often focused on the triggers of development in emerging adulthood (e.g. Bleidorn, 2012; Bleidorn et al., 2013; Lüdtke et al., 2011; Roberts, Caspi, & Moffitt, 2003). This study reaffirms this focus; the sheer number and variety of experiences that emerging adults navigate affords much material for future research. Results of this study and prior research (Allemand et al., 2007) also suggest that the mid-60s may be a time of increasing individual differences in personality change. For the traits of Openness, Conscientiousness, and Agreeableness, a general trend of decreasing individual differences in change across the lifespan is punctuated by an increase in individual differences in change among those ages 60-64. Future research is needed to explore the normative experiences at this age that may explain this pattern, such as retirement or grandparenthood. Regarding specific traits, results of this study suggest that future research is

needed to replicate and extend the finding that individual differences in emotional stability change are relatively prominent and stable across the lifespan and to develop a theoretical explanation for this finding.

It would also be informative for future studies to examine not just mean-level change in response to life events but also the extent to which there is heterogeneity in change following these events. Becoming a parent may not influence mean-level emotional stability change (van Scheppingen et al., 2016), but there may be much individual-level heterogeneity surrounding this life event, such that some new parents are becoming much more emotionally stable and some are becoming much less emotionally stable after the birth of their first child. Because individual differences in personality change across the lifespan are relatively small in magnitude, researchers who investigate explanations for individual differences in personality change must ensure that their studies are highly powered. Effect size estimates from this study can be used to determine the combination of sample size and number of measurement occasions necessary for adequate power to detect these small effects in a general population.

Conclusion

This study was the first to quantify individual differences in personality trait change across the lifespan using a large sample representative of the population of the Netherlands. For four of the Big Five traits (openness, conscientiousness, extraversion, and agreeableness), individual differences in change were greatest in magnitude in emerging adulthood, lesser in magnitude in young and middle adulthood, and smallest in magnitude in old age. These findings provide further support for theories that focus on emerging adulthood as a critical time for personality development. During emerging adulthood, many people deviate from the average developmental trajectory, potentially due to the large number and variety of experiences that

characterize this life stage. In young and middle adulthood as well as in old age, development proceeded more homogenously across the population. Curiously, emotional stability did not follow the same developmental pattern as the other four traits; individual differences in emotional stability change were relatively constant across the lifespan. By describing the patterns of non-normative personality development across the lifespan, we hope to provide a map for future research that seeks to understand why these patterns occur.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The authors received no financial support for the research, authorship, and/or publication of this article

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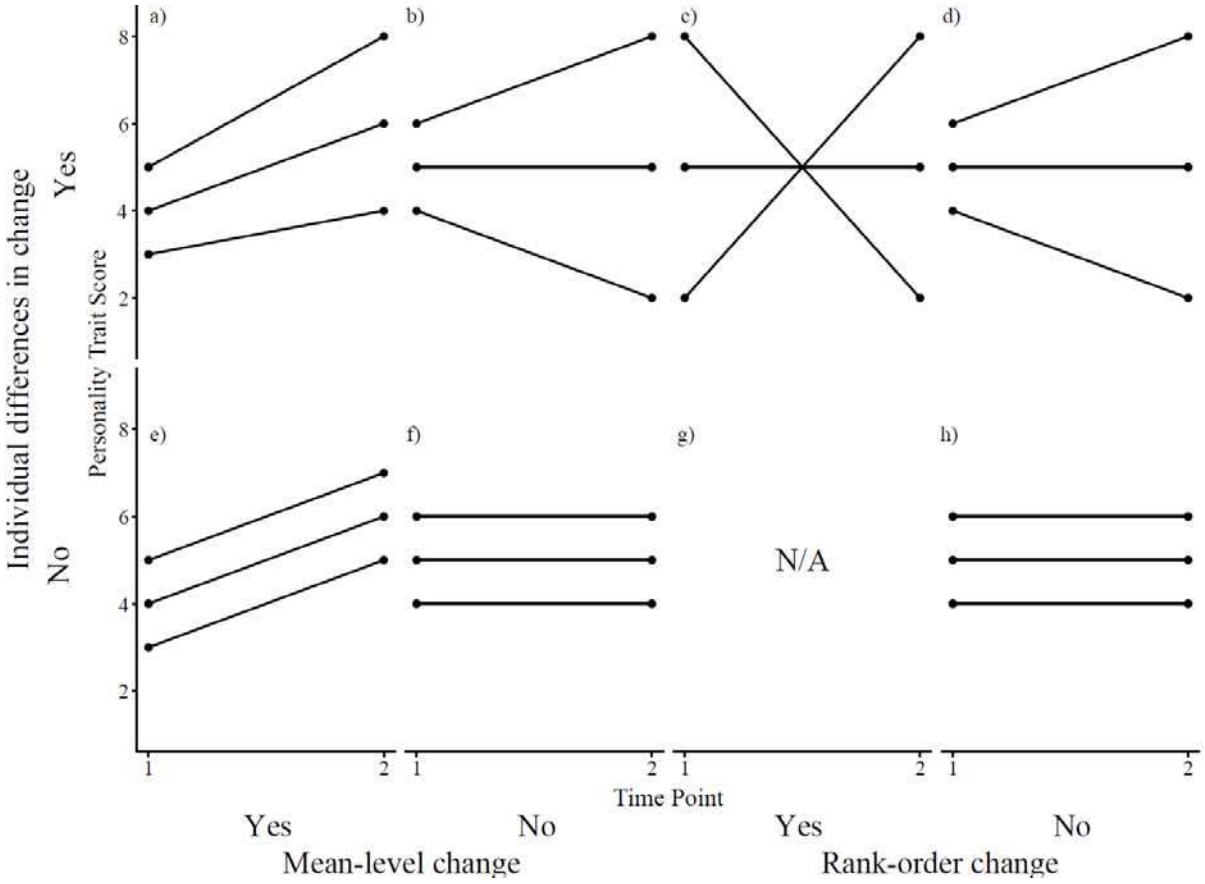
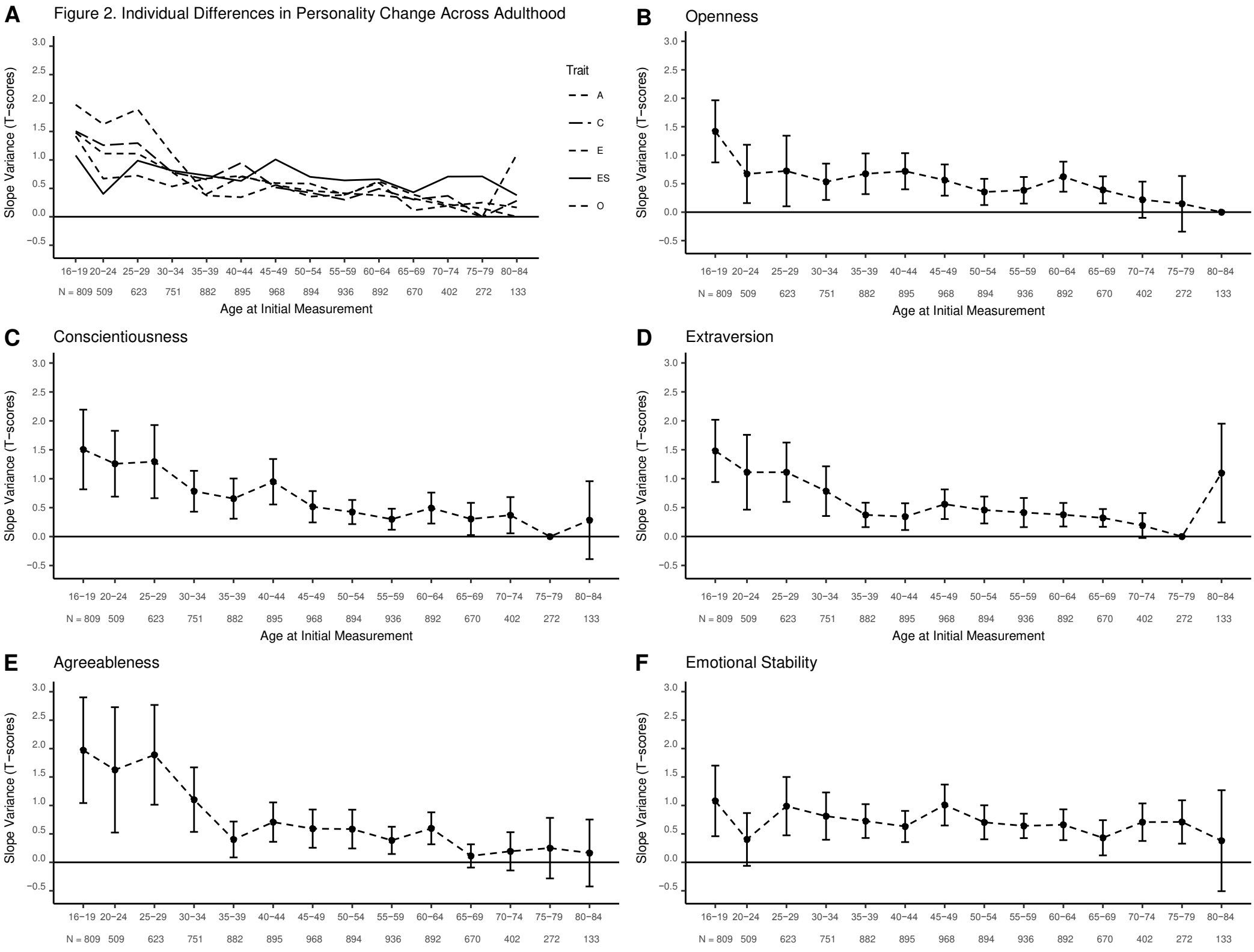


Figure 1. Illustration of individual differences in change, mean-level change, and rank-order change in hypothetical sample of three individuals across two measurement occasions.

		Openness		Conscientiousness		Extraversion		Agreeableness		Emotional Stability	
Age Group	N	Slope variance	95% CI	Slope variance	95% CI	Slope variance	95% CI	Slope variance	95% CI	Slope variance	95% CI
16-19	809	1.42***	[0.87, 1.96]	1.50***	[0.82, 2.19]	1.48***	[0.94, 2.02]	1.97***	[1.04, 2.90]	1.08**	[0.46, 1.70]
20-24	509	0.67*	[0.16, 1.18]	1.26***	[0.69, 1.83]	1.11**	[0.46, 1.76]	1.63**	[0.52, 2.73]	0.40	[-0.06, 0.87]
25-29	623	0.72*	[0.10, 1.34]	1.29***	[0.66, 1.93]	1.11***	[0.60, 1.62]	1.89***	[1.01, 2.77]	0.99***	[0.47, 1.50]
30-34	751	0.53**	[0.21, 0.85]	0.78***	[0.43, 1.14]	0.78***	[0.36, 1.21]	1.10***	[0.54, 1.67]	0.81***	[0.40, 1.23]
35-39	882	0.67***	[0.32, 1.03]	0.66***	[0.31, 1.00]	0.37**	[0.16, 0.58]	0.40*	[0.09, 0.72]	0.72***	[0.43, 1.02]
40-44	895	0.72***	[0.40, 1.04]	0.95***	[0.56, 1.34]	0.34**	[0.11, 0.57]	0.71***	[0.36, 1.05]	0.63***	[0.36, 0.90]
45-49	968	0.56***	[0.29, 0.84]	0.52***	[0.24, 0.79]	0.56***	[0.30, 0.82]	0.59**	[0.26, 0.93]	1.01***	[0.65, 1.37]
50-54	894	0.36**	[0.12, 0.58]	0.42***	[0.22, 0.63]	0.46***	[0.23, 0.69]	0.58**	[0.24, 0.92]	0.70***	[0.40, 1.00]
55-59	936	0.38**	[0.15, 0.62]	0.30**	[0.12, 0.48]	0.41**	[0.16, 0.67]	0.39**	[0.15, 0.62]	0.64***	[0.42, 0.85]
60-64	892	0.62***	[0.36, 0.89]	0.49***	[0.22, 0.76]	0.38***	[0.17, 0.58]	0.60***	[0.32, 0.88]	0.66***	[0.39, 0.93]
65-69	670	0.39**	[0.15, 0.63]	0.30*	[0.02, 0.58]	0.32***	[0.17, 0.48]	0.11	[-0.09, 0.32]	0.43**	[0.12, 0.74]
70-74	402	0.22	[-0.10, 0.54]	0.37*	[0.06, 0.68]	0.19	[-0.02, 0.40]	0.19	[-0.14, 0.53]	0.71***	[0.38, 1.03]
75-79	272	0.15	[-0.34, 0.64]	0.00	NA	0.00	NA	0.25	[-0.28, 0.78]	0.71***	[0.33, 1.09]
80-84	133	0.00	NA	0.28	[-0.39, 0.96]	1.10*	[0.24, 1.95]	0.16	[-0.42, 0.75]	0.38	[-0.51, 1.27]

Table 1. Individual Differences in Personality Change Across Adulthood

Note. Negative variance estimates have been fixed to 0 to facilitate interpretation. * = $p < .05$. ** = $p < .01$. *** = $p < .001$. For full parameter estimates of multiple group latent growth curve models, see Table S6.


A
Figure 2. Individual Differences in Personality Change Across Adulthood
Slope Variance (T−scores)
Trait
A
C
E
ES
O
16−19 20−24 25−29 30−34 35−39 40−44 45−49 50−54 55−59 60−64 65−69 70−74 75−79 80−84
N = 809 509 623 751 882 895 968 894 936 892 670 402 272 133
Age at Initial Measurement
B
Openness
C
Conscientiousness
D
Extraversion
E
Agreeableness
F
Emotional Stability

Note. Error bars represent 95% confidence intervals. Negative slope variances have been fixed to zero.