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RUNNING HEAD: Age differences in personality variance

**Age Differences in the Variance of Personality Characteristics**

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### **Abstract**

In contrast to mean-level comparisons, age group differences in personality trait variance have received only passing research interest. This may seem surprising because individual differences in personality characteristics is exactly what most of personality psychology is about. Because different proposed mechanisms of personality development may entail either increases or decreases in variance over time, the current study is exploratory in nature. Age differences in variance were tested by comparing the standard deviations of the Five-Factor Model (FFM) domain and facet scales across two age groups (20- to 30-year-olds vs. 50- to 60-year-olds). Samples from three cultures (Estonia, the Czech Republic, and Russia) were employed and two methods (self- and informant-reports) were used. The results showed modest convergence across samples and methods. Age group differences were significant for 11 of 150 facet-level comparisons, but never consistently for the same facets. No significant age group differences were observed for the FFM domain variance. Therefore, there is little systematic evidence for individual differences in personality characteristics being smaller or larger in older as opposed to younger people. We discuss the implications of these findings for understanding personality development.

**Keywords:** variance; individual differences; personality; Five-Factor Model

### **Age Differences in the Variance of Personality Characteristics**

Age differences in mean levels of personality characteristics have received considerable empirical and theoretical scrutiny (e.g., Roberts, Walton & Viechtbauer, 2006; Roberts, Wood & Smith, 2005; Mõttus et al., 2015). In contrast, age differences in variance have been paid only passing attention. This relative lack of interest is surprising because variance—or individual differences—is exactly what most of the current personality psychology is about. It would seem natural, then, for personality psychologists to carefully study developmental trends of the magnitude of individual differences. In the simplest terms, this would tell them whether there is more or less of the very thing that they study at different age levels, but this could also shed light on some of the mechanisms of personality development, as will be discussed below. From a methodological point of view, all attempts to find correlates of personality characteristics are inevitably constrained by the amount of variance that is observable. As a result, less variance at some age levels, for example, could mean relatively smaller chances of successfully linking variability in the personality characteristics to behaviour or life outcomes. The present study will describe age-group differences in the variance of personality scale scores in three countries and using different data collection methodologies.

#### *Existent Findings*

Only few studies have tested for age-group differences in variance of personality characteristics and the findings tend to be inconsistent. In a longitudinal study following older people over about 12 years, Allemand, Zimprich and Martin (2008) found that variances of two out of five Five-Factor Model (FFM; McCrae & John, 1992) personality domains—Openness to Experience (Openness) and Conscientiousness—tended to increase over time. However, when Allemand, Zimprich and Hertzog (2007) cross-sectionally compared the

variances of the FFM domains between middle-aged and older people in a German sample, the opposite was observed: older people displayed less variability than middle-aged people in Openness, whereas no variance differences appeared for other domains. In the same vein, McCrae (1993) reported smaller variance in Neuroticism among older people than among younger people, while variances were similar for other FFM domains. Small and colleagues (2003) followed a sample of middle-aged to older people over 6 years and reported equal variances for the FFM domains over the observed period. Likewise, in a cross-sectional study using a large and representative Dutch sample spanning ages 16 to 91, no age group differences in the variance of the FFM domains were observed (Allemand, Zimprich, & Hendriks, 2008). Similarly, no age group differences in the variability of the FFM domains were observed by Soto and colleagues (Soto, John, Gosling, & Potter, 2011) in a large Internet-based sample. The few existing reports have thus provided mixed evidence, which is probably not due to differences across cross-sectional and longitudinal designs.

### *Theoretical Expectations*

It has been proposed that individuals' personalities develop by transacting with their environments (Caspi & Roberts, 2001; Caspi, Roberts, & Shiner, 2005). In particular, people are believed to have a tendency to select themselves into environments that match their personality characteristics, whereas these self-selected environments are likely to influence individuals back. If so, the life experiences that people actively seek or are exposed to may deepen the personality characteristics that lead to these experiences in the first place. This is called the *corresponsive principle* of personality development (Caspi et al., 2005). For example, extraverted people may seek out socially stimulating environments, which may help to develop their social skills and thereby accentuate their Extraversion even further over time. Introverted individuals, in contrast, may avoid such environments and thereby deprive

themselves from practising social skills, which in turn may further lessen their social ambitions over the life course. Indeed, there is evidence consistent with the corresponive principle such that personality characteristics that predict particular life experiences are the same that tend to change over time as a result of these experiences (Jeronimus, Riese, Sanderman, & Ormel, 2014; Le, Donnellan, & Conger, 2013; Middeldorp, Cath, Beem, Willemsen, & Boomsma, 2008; Roberts, Caspi, & Moffitt, 2003).

To the extent that people indeed actively select themselves into environmental niches that deepen their existing personality characteristics, it would also mean that individual differences in personality characteristics tend to increase over time. In other words, older people who have generally had more time and opportunities to select themselves into matching environments and receive reinforcing influences from these self-selected environments should show higher variability among them than younger people who have had less time to actively and systematically transact with the environment.

Of course, the corresponive principle does not have to apply to all personality characteristics. For example, Zimmermann and Neyer (2013) reported it for Openness but not for other FFM domains, whereas Denissen and colleagues (2014) provided evidence for the corresponive principle in Openness and Extraversion. Besides not being uniformly applicable to all FFM domains, it is possible that age differences in variance are masked in broad personality domains that aggregate numerous more specific personality characteristics. It has been argued that personality development happens at least partly at the level of more specific characteristics such as facets (Soto & John, 2012) or even items (Möttus, Realo, et al., 2015) used to operationalize the FFM. Therefore, it may be that people seek out environments that match their specific personality characteristics (e.g., achievement-orientedness) rather than broad personality domains (e.g., Conscientiousness). If so, and to the extent that there is consistency across people in which characteristics are subject to such person-environment

transactions, the corresponive principle could result in age-related increases in the variance of at least a subset of specific characteristics. To the best of our knowledge, only one study has compared age groups in variability of facet scores—and found no differences (Soto et al., 2011). The current study seeks to contribute to the literature by investigating age group differences in the variance of both the FFM domain and facet scales.

As reviewed above, there is little consistent evidence for variance in personality characteristics being larger among older than younger people. This may indicate that the corresponive principle is not accurate. For example, personality development may reflect intrinsic maturation rather than result from person-environment transactions (McCrae & Costa, 2008). However, the corresponive principle might also be correct, but its variance-increasing tendency may be counterbalanced by the operation of some other mechanisms. For instance, the maturity principle postulates that the typical mean-level changes—people becoming more socially dominant, agreeable, conscientious, and emotionally stable with age—reflect socialization processes (Caspi et al., 2005). It is possible that these socialization processes tend to make individuals more alike, thereby offsetting the potential effects of the corresponive principle.

Likewise, besides systematic influences—be these self-selected environmental exposures or social pressures—personality traits may be targets of *random* environmental influences. These may be distributed in such a way that influences contributing to most typical trait levels are more likely than those contributing to extreme trait levels. In other words, random influences on traits may follow the kind of normal distribution that traits themselves tend to do. This may be a sensible default hypothesis, because so many (normal) psychological phenomena are normally distributed. To the extent that this is true, random influences may also tend to make individuals more alike and thereby contribute to decreasing variance—again potentially offsetting variance-increasing tendencies of any systematic

experiences.

As a result, we currently have no clear theoretical expectations as to whether variance in personality characteristics should increase, decrease, or stay constant with age. Although the corresponsive principle in its simplest and unqualified form would suggest increasing variance with age, other systematic or random experiences may offset this tendency, and developmental theories that underscore the role of intrinsic maturation (McCrae & Costa, 2008) may not allow for any specific expectations regarding age-differences in the variance of personality characteristics. We therefore set out to describe age-differences in variance rather than test any specific hypothesis.

#### *Methodological Considerations*

Besides theoretical reasons, methodological issues can contribute to the apparent lack of consistent evidence for age differences in personality variance. For example, age differences in response styles such as socially desirable, acquiescent and extreme responding have been observed (Meisenberg & Williams, 2008; Soubelet & Salthouse, 2011) and it is possible that these mask age differences in variance. For instance, if older people are increasingly likely to give socially desirable responses to personality questionnaire items (Soubelet & Salthouse, 2011), or endorse items regardless of their content (Meisenberg & Williams, 2008), then this may artificially constrain the variance in scores and counterbalance any increases in substantive variability. In contrast, extreme responding is likely to increase apparent variance in items and scales, unless the original distribution is very skewed and extreme responding further increases the floor or ceiling effect (Mõttus et al., 2012).

One way to mitigate this problem is to supplement self-ratings with informant-ratings of personality characteristics (McCrae & Weiss, 2007). Therefore, the present study employs both self- and informant-ratings in two cross-sectional samples from Estonia and the Czech



Republic. Ideally, the informants would be of similar age, in which case age differences in response styles would be effectively controlled for. Based on this rationale, the current study will also employ the ratings of a large sample of Russian students (Allik et al., 2009) who rated the FFM traits and their facets of either a young or older person they knew well. This design may also circumvent the problem of differential self-selection into studies such that older people who are willing to participate in studies, for example, may be more restricted in personality variance than younger participants who are more readily available (although the design may create a new bias—that of differential target selection). Likewise, this design addresses the potential problem of age differences in reliability/internal consistency of personality scales (Soto et al., 2011), which could confound differences in variance because low reliability/internal consistency inevitably constrains variance.

In sum, if age-differences in the variance of personality traits are robust and universal, they should appear as such in this multi-method multi-country study.

## **Method**

### *Participants*

The Estonian sample was based on the Estonian Biobank cohort, which is a volunteer-based sample of the Estonian resident adult population (Leitsalu et al., 2014; Möttus, McCrae, et al., 2014). Self-report data from 727 people aged between 20 and 30 years and 620 people aged between 50 and 60 years was used (total  $N = 1,347$ ; 530 men). Informant-ratings were available for 1,288 of these people (512 men; 698 people in the younger age group). The age of informants ranged from 11 to 81 (only three informants were below age 15; for 76 informants the age was unknown; 31% were men, for 35 informants sex was unknown). The informants were partners or spouses (49.5%), friends or acquaintances (19.0%), parents or grandparents (15.4%), children or grandchildren (7.5%), siblings (6.2%) or other relatives

(2.4%) of the people they rated.

The Czech sample was based on the dataset described in McCrae and colleagues (2004). Data from 442 participants were used, such that 351 individuals (136 men) were aged between 20 and 30 and 91 individuals (44 men) were aged between 50 and 60 years. Informant-ratings were available for all participants and the informants were mostly the partners of the participants (aged between 15 and 77 with a mean of 32 years; 190 of the informants were men).

The Russian sample was based on the dataset of the Russian Character and Personality Survey (Allik et al., 2009); data for 2,000 people aged between 20 and 30 years and 2,250 people aged between 50 and 60 years was used (total  $N = 4,250$ ; 2,287 men). All raters were university students who rated somebody they knew well (for details see Allik et al., 2009).

Two age-groups spanning 10 years—from 20 to 30 and from 50 to 60 years—were used in all analyses for the sake of consistency across samples and age-spans covered in younger and later adulthood. Age levels between 30 and 50 were not used because there was very little data for these ages in the Russian informant-rating sample due to study design (Allik et al., 2009). Participants older than 60 years were not used because of increased risk of this subsample not being population-representative and restricted in variance, and because of a limited number of people. Likewise, it seemed reasonable to expect that the person-environment transactions potentially underlying the corresposive principle should have largely taken place prior to age 60.

### *Measures*

The Form R (Rater or Informant) and Form S (Self) of the Estonian version of the NEO Personality Inventory-3 (NEO-PI-3) were used in the Estonian sample. The NEO-PI-3 is a slightly modified version of the NEO Personality Inventory Revised questionnaire (NEO-PI-

R; McCrae & Costa, 2010). Like the original NEO-PI-R, the NEO-PI-3 has 240 items that measure 30 personality facets which are grouped into the five FFM domains, such that each domain score is a composite of six facet scores. The NEO-PI-3 has excellent psychometric properties in a wide range of countries, including Estonia (De Fruyt, De Bolle, McCrae, Terracciano, & Costa, 2009). The Czech version of the NEO-PI-R (Hrebícková, 2002) was used in the Czech sample (both Form S and R) and the Russian version of the NEO-PI-R (Martin, Costa, Oryol, Rukavishnikov, & Senin, 2002; only Form R) was used in the Russian sample. The Likert-type rating scales ranged from 0 to 4 in all samples.

## **Results**

Variability was operationalized using standard deviations (SD). The likelihood of the group differences in variance not being due to chance (significance) was estimated using the Levene's test of equality of variances. Because of the large number of comparisons (35 scales in three sets of data), a conservative significance threshold was used: only those true group differences significant at 0.1% alpha level (i.e.,  $p < .001$ ) were considered present beyond chance. For the FFM traits and their facets, the SDs for both age groups (i.e., 20-30 and 50-60 years, respectively) in all samples are reported in Table 1 along with the significance estimates of age group differences. In order to efficiently summarize the information, Figure 1 depicts the ratios of SDs in all samples, such that ratios over 1 indicate higher variation in the younger group as opposed to the older group.

Figure 1 conveys the following three major findings. First, there was only modest consistency across the five sets of ratings (i.e., both self- and informant-ratings of personality in the Estonian and the Czech sample and the informant-ratings in the Russian sample). We calculated Spearman rank-order correlations between the SD ratios of the 30 facets across the five sets of ratings. The correlations varied from -.27 to .51 (median of .17), with only two

being significant at  $p < .001$  (the SD ratios of Russian informant-ratings were significantly correlated with SD ratios in Estonian and Czech informant-ratings, although the latter two were not significantly correlated).

Second, the ratios tended to fluctuate around unity, suggesting no consistent tendency for variance in personality characteristics being generally larger in either among younger or older people. Only a few scales showed significant ( $p < .001$ ) age group differences in variance. In self-reports, all significant age group differences pertained to scales in which younger people had higher variances than older people: N2: Hostility, N3: Depression, O6: Openness to Values, A5: Modesty and C5: Self-Discipline. In Estonian and Czech informant-reports as well as Czech self-reports, no age group difference in variance was significant. In Russian informant-reports, variance was significantly higher among younger people in N4: Self-Consciousness and O3: Openness to Feelings, whereas the variance was significantly higher for older people in E1: Gregariousness, E5: Excitement-Seeking, A3: Altruism and A6: Tendermindedness. For no domain or facet scale, significant group difference was simultaneously present across the five sets of ratings, or even across any two sets (which means that lack of consistency in significance was not due to limited statistical power in the Czech sample, for example).

Third, there did not appear to be systematic differences across the FFM domains in age differences in variance. If anything, variance in Neuroticism and Conscientiousness seemed to be somewhat more consistently larger in younger people than in older people, but this tendency was barely noticeable and could easily reflect random fluctuations.

In Estonian informant-rating data, we additionally limited the sample to those participants whose informants were aged between 20 and 30 years, in order to control for the age of informants, similarly to the Russian sample. This resulted in having 459 people in the younger group and 109 people in the older group. This restriction did not result in more

support for age group differences in variance, because differences were significant for none of the scales. The SD ratios in this subsample of informant-reports correlated to these in the Russian informant-ratings at  $\rho = -.04$  across the 30 facets. Because this correlation had been .47, when the full set of Estonian informant-reports was used, controlling for informants' age did not appear to make the results from the two sets of informant-ratings more similar—if anything, the opposite was the case. We did not carry these additional analyses out in the Czech sample because this would have resulted in insufficient number of observations ( $N = 10$ ) in the older age group.

#### *Possible Confounding Factors*

It is possible that the age group differences in variance reported above were confounded by differences in mean levels of personality scales or other variance-relevant factors. For example, scores in one age group could have been closer to the maximum or minimum values of the scales than those in another age group, causing stronger ceiling or floor effect and thereby artificially more restricted variance. If so, scales with larger absolute group differences in variance should also have been the scales with larger absolute age group differences in mean values or closeness of the mean values to scale endpoints. However, this did not appear to be the case. Across the 30 facets, the absolute values of the group differences in variance were generally not significantly correlated with absolute values of age group differences in mean scores ( $\rho = -.45$  to  $.20$ ) or in how close the mean scores were to scale endpoints ( $\rho = -.13$  to  $.24$ ); the one significant correlation of  $-.45$  (for Czech informant-ratings) was likely to reflect a statistical fluke.

Age group differences in personality scale variance could also have been confounded by differential reliability, because reliability sets limits to variance (see Allik et al., 2010, as an example). For example, it was possible that internal consistencies of personality scales tended

to be lower among younger people (Soto et al., 2011), which could decrease observable variance among them. In all samples, we compared the internal consistencies (Cronbach's alphas) of 30 facets across the two age groups and found that the alphas tended to be slightly lower among older people in Estonian self-ratings and in Czech self- and informant-ratings (median differences in alphas were .03, .04 and .04, respectively), whereas the difference was even more negligible in Estonian informant-ratings (median difference in alphas .01) and non-existent in Russian informant-ratings (note that all raters were students in this sample, so finding no difference in alphas was expected).

However, the problem is more complex, because internal consistency is inherently intertwined with variance (i.e., it is part of the formula of Cronbach's alpha) such that lower variance itself entails lower internal consistency. In other words, lower variance could result from lower internal consistency, but low internal consistency estimates themselves may also have resulted from lower variance. We therefore used an alternative method for estimating reliability. Assuming that error-free cross-rater agreement was not systematically associated with age (we acknowledge that the assumption may ultimately prove wrong), age group differences in observed cross-rater agreement would reflect differential reliability or biases (cf. McCrae, 2015). We therefore calculated cross-rater correlations for the 30 facets separately among younger and older people in Estonian and Czech samples (in the Russian sample, all raters were young anyway). We then calculated age group differences in these correlations and linked these to age group differences in variance (in self- and informant-ratings). Positive correlations (across the 30 facets) between age differences in cross-rater agreement and age differences in variance could have indicated that variance decreased more in those facets that showed biggest drop in error-free variance. However, none of the correlations was significant ( $\rho = -.13$  to  $.28$ ), although cross-rater agreements tended to be slightly lower among older participants (median drop in agreements were .04 and .05,

respectively in Estonian and Czech data). The latter finding is consistent with age group differences in Cronbach's alphas.

Finally, we note that in the analyses based on Russian data and in the supplementary analyses based on Estonian informant-ratings provided by younger raters, the effect of rater age was effectively controlled for. As shown, this did not result in systematically different patterns of findings. Overall, thus, there was little evidence for age group differences in variance being confounded by differential reliability.

#### *Additional Analyses on Younger People*

To test for the possibility that the person-environment transactions that may result in increasing individual differences take place earlier in life, we sampled two additional age groups from the Estonian Genome Bank and Russian Character and Personality Survey datasets: one consisting of people aged between 16 to 20 and the other consisting of people aged between 21 to 25 years. In the Estonian sample, the sizes of the age groups were 156 and 283 people, respectively, whereas in the Russian sample the group sizes were 2,707 and 798 people, respectively. Only one significant ( $p < .001$ ) group difference emerged from the three sets of ratings (for C5: Self-Discipline in the Russian sample; variance was larger among younger participants). Therefore, there was also little support for increases or decreases in variances during the emerging adulthood.

### **Discussion**

The results of this well-powered study that used multiple samples and multiple methods indicate that there may exist occasional age group differences in the variance of personality scales. However, the number of significant differences was modest and the significant differences were not consistent across different methods and samples. But even as a tendency, it did not appear to be the case that individual differences were systematically larger among

older (aged between 50 and 60 years) people as opposed to younger people (aged between 20 and 30 years), and neither was the reverse necessarily true.

Lack of systematic age group differences in the variance of personality characteristics is generally consistent with the few previous studies addressing this question (e.g., Allemand et al., 2008; McCrae, 1993). However, previous studies have rarely investigated age group differences in variance at the level of facets (Soto et al., 2011), whereas in the present study facets were exactly the level of analysis where significant group differences appeared. Age group differences were significant for 7% (11 out of 150) of facet-level comparisons, but for none of the 25 domain-level comparisons. As a result, if there will be further research into the question, it may be worthwhile to focus on more specific personality characteristics such as facets or even items/nuances (McCrae, 2015) than the FFM domains. Lack of systematic age differences in variance did not appear to be due to methodological issues such as age-related rating biases or differential sample selection, therefore future studies may well rely on self-report designs.

The study focused on comparing people in young adulthood (between 20 and 30 years of age) to people in later adulthood (between 50 and 60 years of age), but similar lack of systematic age difference in personality variance was found when people aged between 16 to 20 years were compared to those aged between 21 and 25. Therefore, findings are likely to generalize across periods from emerging to later adulthood.

#### *Implications for Understanding Personality Development*

To the extent the corresposive principle (Caspi et al., 2005) implies accentuation of individual differences as a function of development, the present findings appear to offer little support for it. However, there may be ways of reconciling the said principle with the present findings. For example, it could be that there are other principles pertinent to personality



development that counterbalance the influence of the corresponive principle. It is possible that the socialization processes potentially underlying the maturity principle may tend to make people more similar to each other over time. Also, random influences may be more likely to make people more alike than contribute to extreme trait levels, and thereby decrease variance over time.

Moreover, we propose another possibility that may reconcile the present findings with the corresponive principle. It may be that individuals do not seek environments that match *all* of their personality characteristics at the same time. Instead, they may seek person-environment fit for only some characteristics—for example, those that happen to be particularly salient for them or are particularly central in their personality networks (Costantini et al., 2015). If so, it may also be that what exactly these salient or central characteristics are differs across people. As a result, by way of such selective person-environment transactions, people may idiosyncratically accentuate some personality characteristics, whereas other characteristics may remain unaffected or even drift towards normative levels. For instance, the kinds of psychological activities that make up one's personality (emotions, behaviours, cognitions) may be a limited resource and investing it more in some characteristics may mean that there is less of it for other characteristics to be actively invested in.

Considering such idiosyncratic reallocations of personality activity as a developmental principle may mean that person-environment transactions may, in principle, be consistent with the corresponive principle without necessarily implying development-related increases in individual differences. This is, of course, only a speculative hypothesis that does not follow from our data, but it may serve as input for future theorizing on personality development. One potential albeit indirect test of this hypothesis could be based on longitudinal data: we would expect that individuals' average levels of personality scores—across a wide range of

characteristics—remain relatively constant over time.

Either way, the present findings suggest that the corresponive principle could, and perhaps should, be elaborated to account for the lack of systematic age differences in variance of personality characteristics. As it stands, the principle suggests that (non-random) life experiences tend to “deepen the characteristics that lead people to those experiences in the first place” (Roberts et al., 2003, p. 583), which, if not qualified, almost inevitably seems to imply variance increases over time. An elaborated form of the principle could postulate the reasons for which—or conditions in which—this tendency would not be observable.

As one option, the corresponive principle could be revised with the help of simulation studies. Such studies would allow for testing under which circumstances the corresponive mechanisms—personality characteristics contributing to people's typical environmental experiences and these experiences contributing back to personality characteristics—could, in principle, lead to increased, decreased or relatively stable levels of variance over time. Since the current evidence seems to suggest relatively stable variance (on average), the simulation scenario(s) that entail(s) this outcome would appear more plausible and could provide input to the refined corresponive principle. The feasibility of the hypotheses proposed above—that random environmental influences and experience that most people share (e.g., socialization pressures) contribute to decreases in variance over time and thereby counterbalance the influences of the corresponive principle, or that person-environment transactions are idiosyncratic and specific to limited (but identifiable) subsets of characteristics—could be tested using simulation designs.

Simulations could also lead to alternative predictions. For example, one possible outcome of the simulations is this: if personality characteristics contribute to people's typical environmental experiences and these experiences contribute back to personality characteristics, the two become increasingly correlated over time (i.e., over life-course). If so,

this becomes a testable hypothesis and, depending on the outcome of relevant empirical tests, the simulation scenario(s) that either give(s) or do(es) not give rise to this tendency would appear more plausible.

On a related note, the present findings may have implications for other simulation studies that address personality development but are not necessarily focusing on variance (e.g., Read et al., 2010). For example, Fraley and Roberts (2005) simulated potential influences of person-environment transactions on the rank-order stability of personality characteristics. Their mathematical model appeared to *assume* that the variance of latent personality characteristics was constant over time—the present findings appear to support this assumption.

### *Limitations*

The primary limitation of the study is that it is based on cross-sectional data and any observed age group differences may be confounded by variables other than age. First, cohort effects may have played a role. For example, to a lesser or greater extent, all three countries under investigation—Russia, Estonia and the Czech Republic—have a Soviet/Communist legacy, which may have influenced personality development. This is particularly true for older people, because the younger age groups have been less exposed to this legacy. We therefore encourage studies on age differences in personality characteristic variance to be carried in a wider range of countries. Ideally, such studies could be collated as a meta-analysis. Second, differential self-selection into the study may have biased the self-report based results. This bias, however, was unlikely in the findings based on Russian informant-reports because all raters were relatively similar in age, whereas the people being rated were not participants themselves at all. Future studies could make use of longitudinal data spanning several measurement occasions over decades to study age differences in the variance of

personality characteristics. A further limitation may be that the three samples came from different countries and inconsistencies between findings may at least partly be ascribed to this. But then, age group differences in self- and informant-reports pertaining to the same sample of Estonians were not substantially more consistent than they were with the findings in the Czech and Russian samples, and the same was true for the Czech findings. This suggests that cultural differences were not the only source of inconsistency. Finally, age differences in variance should also be studied in personality characteristics other than those incorporated in the FFM.

### *Conclusion*

Despite there being theoretical reasons to expect age differences in the variance of personality characteristics, the current multi-sample multi-method study found that on average, individual differences were of similar magnitude among older and younger people. This finding is likely to have implications for theorizing about the mechanisms of personality development. For example, the corresponsive principle of personality development could be refined to account for this finding.

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## References

- Allemand, M., Zimprich, D., & Hendriks, A. A. J. (2008). Age differences in five personality domains across the life span. *Developmental Psychology, 44*, 758–770. doi:10.1037/0012-1649.44.3.758
- Allemand, M., Zimprich, D., & Martin, M. (2008). Long-term correlated change in personality traits in old age. *Psychology and Aging, 23*, 545–557. doi:10.1037/a0013239
- Allemand, M., Zimprich, D., & Hertzog, C. (2007). Cross-sectional age differences and longitudinal age changes of personality in middle adulthood and old age. *Journal of Personality, 75*, 323–358. doi:10.1111/j.1467-6494.2006.00441.x
- Allik, J., Realo, A., Mõttus, R., Esko, T., Pullat, J., & Metspalu, A. (2010). Variance determines self-observer agreement on the Big Five personality traits. *Journal of Research in Personality, 44*, 421–426. doi: 10.1016/j.jrp.2010.04.005
- Allik, J., Realo, A., Mõttus, R., Pullmann, H., Trifonova, A., & McCrae, R. R. (2009). Personality traits of Russians from the observer's perspective. *European Journal of Personality, 23*, 567–588. doi:10.1002/per.721
- Caspi, A., & Roberts, B. W. (2001). Personality development across the life course: The Argument for Change and Continuity. *Psychological Inquiry, 12*, 49–66. doi:10.2307/1449487
- Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: stability and change. *Annual Review of Psychology, 56*, 453–484. doi:10.1146/annurev.psych.55.090902.141913
- Costantini, G., Epskamp, S., Borsboom, D., Perugini, M., Mõttus, R., Waldorp, L. J., & Cramer, A. O. J. (2015). State of the aRt personality research: A tutorial on network

- analysis of personality data in R. *Journal of Research in Personality*, *54*, 13–29. doi: 10.1016/j.jrp.2014.07.003
- De Fruyt, F., De Bolle, M., McCrae, R. R., Terracciano, A., & Costa, P. T. (2009). Assessing the universal structure of personality in early adolescence: The NEO-PI-R and NEO-PI-3 in 24 cultures. *Assessment*, *16*, 301–311. doi:10.1177/1073191109333760
- Denissen, J. J. A., Ulferts, H., Lüdtke, O., Muck, P. M., & Gerstorf, D. (2014). Longitudinal transactions between personality and occupational roles: A large and heterogeneous study of job beginners, stayers, and changers. *Developmental Psychology*, *50*, 1931–1942. doi:10.1037/a0036994
- Fraley, R. C., & Roberts, B. W. (2005). Patterns of continuity: a dynamic model for conceptualizing the stability of individual differences in psychological constructs across the life course. *Psychological Review*, *112*, 60–74. doi: 10.1037/0033-295X.112.1.60
- Hrebícková, M. (2002). Internal consistency of the Czech version of the NEO Personality Inventory (NEO-PI-R). *Ceskoslovenska Psychologie*, *46*, 521–535.
- Jeronimus, B. F., Riese, H., Sanderman, R., & Ormel, J. (2014). Mutual reinforcement between neuroticism and life experiences: A five-wave, 16-year study to test reciprocal causation. *Journal of Personality and Social Psychology*, *107*, 751–764. doi:10.1037/a0037009
- Leitsalu, L., Haller, T., Esko, T., Tammesoo, M.-L., Alavere, H., Snieder, H., ... Metspalu, A. (2014). Cohort Profile: Estonian Biobank of the Estonian Genome Center, University of Tartu. *International Journal of Epidemiology*. doi:10.1093/ije/dyt268
- Le, K., Donnellan, M. B., & Conger, R. (2013). Personality Development at Work: Workplace Conditions, Personality Changes, and the Correspondive Principle. *Journal of Personality*, *82*, 44-56. doi:10.1111/jopy.12032

- Martin, T. A., Costa, P. T., Oryol, V. E., Rukavishnikov, A. A., & Senin, I. G. (2002). Applications of the Russian NEO-PI-R. In R. R. McCrae & J. Allik (Eds.), *The Five Factor Model of personality across cultures* (pp. 261–277). New York: Kluwer Academic/Plenum Publishers.
- McCrae, R. R. (1993). Curiouser and curiouser! Modifications of a paradoxical theory of personality coherence. *Psychological Inquiry*, 4, 300–303. doi:10.1207/s15327965pli0404\_12
- McCrae, R. R. (2015). A more nuanced view of reliability: Specificity in the trait hierarchy. *Personality and Social Psychology Review*, 19, 97–112. doi:10.1177/1088868314541857
- McCrae, R. R., & Costa, P. T. (2008). The five-factor theory of personality. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (3rd ed.). (pp. 159–181). New York, NY US: Guilford Press.
- McCrae, R. R., & Costa, P. T. (2010). *NEO Inventories professional manual*. Odessa, FL: Psychological Assessment Resources.
- McCrae, R. R., Costa, P. T., Martin, T. A., Oryol, V. E., Rukavishnikov, A. A., Senin, I. G., ... Urbánek, T. (2004). Consensual validation of personality traits across cultures. *Journal of Research in Personality*, 38, 179–201. doi:10.1016/S0092-6566(03)00056-4.
- McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60, 175–215. doi:10.1111/j.1467-6494.1992.tb00970.x
- McCrae, R. R., & Weiss, A. (2007). *Observer ratings of personality*. In R. W. Robins, R. C. Fraley, & R. Krueger (Eds.), *Handbook of Research Methods in Personality Psychology*. (pp. 259–272). New York, NY: The Guildford Press.



- Meisenberg, G., & Williams, A. (2008). Are acquiescent and extreme response styles related to low intelligence and education? *Personality and Individual Differences, 44*, 1539–1550. doi:10.1016/j.paid.2008.01.010
- Middeldorp, C. M., Cath, D. C., Beem, A. L., Willemsen, G., & Boomsma, D. I. (2008). Life events, anxious depression and personality: a prospective and genetic study. *Psychological Medicine, 38*, 1557–1565. doi:10.1017/S0033291708002985
- Mõttus, R., Allik, J., Realo, A., Rossier, J., Zecca, G., Ah-Kion, J., ... Johnson, W. (2012). The effect of response style on self-reported Conscientiousness across 20 countries. *Personality & Social Psychology Bulletin, 38*, 1423–1436. doi: 10.1177/0146167212451275
- Mõttus, R., McCrae, R. R., Allik, J., & Realo, A. (2014). Cross-rater agreement on common and specific variance of personality scales and items. *Journal of Research in Personality, 52*, 47–54. doi:10.1016/j.jrp.2014.07.005
- Mõttus, R., Realo, A., Allik, J., Esko, T., Metspalu, A., & Johnson, W. (2015). Within-trait heterogeneity in age group differences in personality domains and facets: Implications for the development and coherence of personality traits. *PLOS ONE, 10*, e0119667. doi: 10.1371/journal.pone.0119667
- Read, S. J., Monroe, B. M., Brownstein, A. L., Yang, Y., Chopra, G., & Miller, L. C. (2010). A neural network model of the structure and dynamics of human personality. *Psychological Review, 117*, 61–92. doi: 10.1037/a0018131
- Roberts, B. W., Caspi, A., & Moffitt, T. E. (2003). Work experiences and personality development in young adulthood. *Journal of Personality and Social Psychology, 84*, 582–593. doi: 10.1037/0022-3514.84.3.582

- Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *132*, 1–25. doi: 10.1037/0033-2909.132.1.1
- Roberts, B. W., Wood, D., & Smith, J. L. (2005). Evaluating Five Factor Theory and social investment perspectives on personality trait development. *Journal of Research in Personality*, *39*, 166–184. doi: 10.1016/j.jrp.2004.08.002
- Small, B. J., Hertzog, C., Hulstsch, D. F., & Dixon, R. A. (2003). Stability and change in adult personality over 6 years: findings from the Victoria Longitudinal Study. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *58*, P166–176.
- Soto, C. J., & John, O. P. (2012). Development of Big-Five Domains and Facets in Adulthood: Mean-Level Age Trends and Broadly Versus Narrowly Acting Mechanisms. *Journal of Personality*, *80*, 881–914. doi:10.1111/j.1467-6494.2011.00752.x
- Soto, C. J., John, O. P., Gosling, S. D., & Potter, J. (2011). Age differences in personality traits from 10 to 65: Big Five domains and facets in a large cross-sectional sample. *Journal of Personality and Social Psychology*, *100*, 330–348. doi:10.1037/a0021717
- Soubelet, A., & Salthouse, T. A. (2011). Influence of Social Desirability on Age Differences in Self- Reports of Mood and Personality. *Journal of Personality*, *79*, 741–762. doi:10.1111/j.1467-6494.2011.00700.x
- Zimmermann, J., & Neyer, F. J. (2013). Do we become a different person when hitting the road? Personality development of sojourners. *Journal of Personality and Social Psychology*, *105*, 515–530. doi: 10.1037/a0033019

**Figure captions**

Figure 1. Ratios between age groups in standard deviations (younger group/older group) for the FFM traits and their facets. For full scale names see Table 1.