Personality maturation around the world

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Supplemental Material

Measurement Invariance

Measurement invariance of the Big Five scales across cultures was tested for the purposes of another study using the current data set (Gebauer, Bleidorn, Gosling, Rentfrow, & Potter, 2013). Specifically, using multi-group confirmatory factor analyses across an extended sample of 66 countries, we found scalar invariance for the scales of agreeableness, conscientiousness, openness, and extraversion. Only the neuroticism scale did not fully meet the strict criteria for this strongest type of measurement invariance, which assures equivalent scale intervals and scale origins or zero points across cultures (Cheung & Rensvold, 2002). It is important to note that scalar invariance is crucial for an unambiguous interpretation of differences in absolute trait levels across cultures, but it is less essential for our focus on differences in relative age-effects on personality traits within cultures.

Multilevel Analyses

To address the research questions of the current study, a series of two-level models were estimated. For each Big Five trait, we first specified a random-coefficient-regression model (Hox, 2002) including age and gender as continuous explanatory variables at level 1. Specifically, the model at level 1 was specified as

$$Y_{ij} = \beta_{0j} + \beta_{1j}\,(age_{ij}) + \beta_{2j}\,(gender_{ij}) + r_{ij}\,, \qquad [1.1]$$

where Y_{ij} represents the particular Big Five trait score for individual i in nation j, β_{0j} is the intercept, $\beta_{1j}\,(age_{ij})$ is the regression slope for the explanatory variable age, $\beta_{2j}\,(gender_{ij})$ is the regression slope for the explanatory variable gender, and r_{ij} is the residual error term. Because of the scaling of both explanatory variables, the fixed effects can be interpreted as referring to the expected outcomes for a male individual aged 16-20. Both intercept and

regression slopes are assumed to vary across nations in the unconditional level-2 model as a function of the grand mean and random error:

$$\beta_{0j} = \gamma_{00} + + \mu_{0j}\,, \quad [1.2]$$

$$\beta_{1j} = \gamma_{10} + + \mu_{1j}\,, \quad [1.3]$$

$$\beta_{2j} = \gamma_{20} + + \mu_{2j}\,, \quad [1.4]$$

Substituting equations 1.2 to 1.4 into equation 1.1 yields a mixed model:

$$Y_{ij} = \gamma_{00} + \gamma_{10}\,(age_{ij}) + \gamma_{20}\,(gender_{ij}) + \mu_{0j} + \mu_{1j}\,(age_{ij}) + \mu_{2j}\,(gender_{ij}) + r_{ij}\,,$$

where γ_{00} is the average Big Five trait score across the population of *j* nations, γ_{10} and γ_{20} are the average regression slopes for age and gender across those nations, μ_{0j} is the unique increment to the intercept associated with nation *j,* and μ_{1j} and μ_{2j} are the unique increments to the regression slopes for age and gender associated with nation *j.* These residual terms μ_j are assumed to have a mean of zero and a specific variance:

$$Var(\mu_{0j}) = \sigma_{0j} \quad [1.5]$$

$$Var(\mu_{1j}) = \sigma_{1j} \quad [1.6]$$

$$Var(\mu_{2j}) = \sigma_{2j} \quad [1.7]$$

In a second step, we sought to explain the variability of age effects on personality across nations and extended our initial models by including the explanatory culture-level variables at level 2. In these so-called intercept-and-slope-as-outcome models (Raudenbush & Bryk, 2002), the level-1 model remains the same as in equation 1.1. However, the level-2 model now incorporates the two grand-mean centered culture-level predictors indicating the normative timing of family-role and job-role transitions:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,(JOB_{\,j}) + \gamma_{02}\,(FAMILY_{\,j}) + \mu_{0j}\,, \quad [1.8]$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\,(JOB_{\,j}) + \gamma_{12}\,(FAMILY_{\,j}) + \mu_{1j}\,, \quad [1.9]$$

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$$\beta_{2j} = \gamma_{20} + + \mu_{2j}\,, \qquad [1.10]$$

Substituting equations 1.8 to 1.10 into equation 1.1 yields:

$$Y_{ij} = \gamma_{00} + \gamma_{01}\,(\text{JOB}_{j}) + \gamma_{02}\,(\text{FAMILY}_{j}) + + \gamma_{10}\,(\text{age}_{ij}) + \gamma_{20}\,(\text{gender}_{ij}) + \gamma_{11}\,(\text{JOB}_{j})\,(\text{age}_{ij})$$

$$+ \gamma_{12}\,(\text{FAMILY}_{j})\,(\text{age}_{ij}) + \mu_{0j} + \mu_{1j}\,(\text{age}_{ij}) + \mu_{2j}\,(\text{gender}_{ij}) + r_{ij}\,, \qquad [1.11]$$

which illustrates that the outcome is considered as a function of the overall intercept (γ_{00}), the main effect of JOB (γ_{01}), the main effect of FAMILY (γ_{02}), the main effects of age (γ_{10}) and gender (γ_{20}), and two cross-level interactions involving JOB with age (γ_{11}) and FAMILY with age(γ_{12}), plus a random error component $\mu_{0j} + \mu_{1j}\,(\text{age}_{ij}) + \mu_{2j}\,(\text{gender}_{ij}) + r_{ij}$.

Because of the scaling of the level-1 variables and the grand-mean centering of the two level-2 explanatory variables, the fixed effects of the final models can be interpreted as referring to the expected outcomes for a male individual aged 16-20 from a culture with average scores on the FAMILIY and/ or JOB indexes.

Auxiliary Statistics

An important effect-size concept in ordinary multiple regression analysis is the R^2 statistic, which represents the proportion of outcome variance explained by the explanatory variables. In multilevel regression analyses, an analogue index can be computed by comparing the variance components from a baseline model (without explanatory variables) with the residual variances in the full model including the significant predictor variables (Aguinis, Gottfredson, & Culpepper, in press; Raudenbush & Bryk, 2002). In the current study, we drew on this index as an approximate effect-size measure. It is important to note that more than one R^2 index can be computed in multilevel regression models. First, there is unexplained variance at different levels of the model, and second, not only variance in the outcome itself but also in the slopes can be explained at the next higher level of the model (Hox, 2002).

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In the models reported herein, the level-2 variance components of the age slopes were of particular interest. Specifically, we looked at the proportional reduction of culture-level variance in the slopes for age effects after including the JOB and FAMILY indexes as explanatory variables at level 2 (i.e. , the cross-level interactions):

$$R^2_{(\mu 1)} = \left[\frac{\sigma^2(\mu 1|\text{base}) - \sigma^2(\mu 1|\text{full})}{\sigma^2(\mu 1|\text{base})}\right], \quad [1.12]$$

where $\sigma^2_{(\mu 1|\text{base})}$ is the culture-level residual variance in the age slopes from the baseline model, which is the random-coefficient-regression model, and $\sigma^2_{(\mu 1|\text{full})}$ is the culture-level residual variance from the full model, which is the intercept-and-slope-as-outcome model including the level-2 explanatory variables.

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