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RESEARCH

The Assessment and Heritability of a Brief Measure of Agency

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Abstract

The interpersonal circumplex describes two major axes of personality that guide much of social behavior. Agency, one half of the interpersonal circumplex, refers to relatively stable behavioral patterns that center on self-focused dominance and assertiveness assessed in terms of goals, values, or personality traits. However, the psychometric overlap between agency and the most closely linked big five dimension, extraversion, is not well-established, and little behavior genetic work has documented evidence concerning the role of genetic and environmental influences on trait agency. We used the Midlife Development in the United States study to examine agency, big five, and generativity with replication and robustness checks ($N_{non-twins}$ = 5,194; N_{twins} = 1,914; $N_{Milwaukee}$ = 592). Results indicated that agency was higher in men (d = −0.24), moderately heritable (44.4%), strongly correlated with extraversion (r = .51), moderately correlated with generativity (r = .36), and approximately 41% of the variance in agency was shared with the big five. The current brief measure of agency across two samples reflected smaller gender differences than historical expectations but supported its distinction from the big five traits at the current levels of analysis.

Keywords Agency · Big five · Generativity · Gender differences · Twin study

The interpersonal circumplex (Bakan 1966; Wiggins 1979) describes two major axes that guide interpersonal behavior, agency (i.e., getting ahead) and communion (i.e., getting along). The interpersonal circumplex is used as an organizing framework across psychology disciplines to study, for example, values or goals (Trapnell and Paulhus 2012), gender roles (Bem 2011; Hsu et al. 2021), self-enhancement (Paulhus and John 1998), interpersonal problems (Alden et al. 1990), and personality structure (Gurtman and Pincus 2003; Wiggins 1979). As a personality trait, agency captures self-focused dominance. There is no singular consensus on either a conceptualization or measurement of agency. Instead, it varies by research domain or discipline (Abele 2003; Alden et al. 1990; Bem 2011; Hogan 1983; McAdams 1988; Spence and Helmreich 1979; Wiggins 1979). One common conceptualization of agency-communion was to relabel masculinity-femininity measures (e.g., Bem Sex Role Inventory and Personal Attributes Questionnaire). Indeed, individuals expect (Eagly and Karau 2002; Eagly and Wood 2012) and self-report (Badura et al. 2018; Feingold 1994; Hsu et al. 2021) higher levels of agency among men. However, the explicit conflation of agency with masculinity measures leaves open a lot of questions around the instantiation of a trait measure of agency within the personality literature, including the amount of variation due to genetic and environmental influences.

Genetic research into agency, using a twin study design, in addition to the phenotypic research provides not only an estimate of the heritability of agency, but also, allows a decomposition of the covariation among phenotypes into what is shared genetic influences and shared environmental influences. Because heritability is a population level estimate of the ratio of total genetic variance to total phenotypic variance (Johansen 2018), it offers a supplemental, or secondary level of analysis, that quantifies a parameter relevant to the time of the study and nature of the sample.

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Here, we test the psychometric and biometric properties of a short measure of agency in the Midlife Development in the United States (MIDUS) study. Specifically, we examined how agency conforms and deviates from theoretical expectations by addressing its relationships to gender, big five, and generativity using correlations, regressions, and behavior genetic modeling. We used the non-twin, twin, and Milwaukee samples from MIDUS to replicate our results and check for robustness.

Nomological Network of Agency

Agency is related to career success (Abele 2003), judgments of status (Fiske et al. 2007), self-perceptions (Wojciszke et al. 2011), and power and achievement (Trapnell and Paulhus 2012). Yet research domains differ on the conceptualization and measurement of agency as explicit and implicit ties were made to masculinity and dominance (Abele 2003; Alden et al. 1990; Bem 2011; Hogan 1983; McAdams 1988; Spence and Helmreich 1979; Wiggins 1979). In a meta-analysis of 100,915 participants from 409 studies, Badura and colleagues (2018) found that men score significantly higher on self-report measures of agency than women ($\delta = 0.48$). Importantly, the effect sizes derived to estimate gender differences in agency were based on measures explicitly measuring masculinity (e.g., Bem Sex role Inventory; Personal Attributes Questionnaire) highlighting the conflation of these constructs in the literature. Situating agency within the larger construct space of psychological individual differences can aid interpretation and translation across research domains.

Abele and colleagues (2016) compared a newly constructed Agency-Communion scale to the big five in samples from Germany ($N = 476$), France ($N = 250$), and Australia ($N = 140$). The big five traits dominate the study of personality; the five traits refer to characteristic patterns of thinking, feeling, and behaving. At the trait-level, they are measured as extraversion—sociable and energetic, agreeableness—compliant and trusting, conscientiousness—organized and responsible, neuroticism—anxious and emotionally volatile, and openness to experience—intellectually curious and imaginative (Soto and John 2017). Abele and colleagues (2016) assessed agency as assertive and competent, while communion was warm and moral. The agency-assertive facet was most strongly associated with extraversion ($r = .37$ −.57) and neuroticism (-0.28 - −0.56), less strongly with conscientiousness (0.19 −0.34) and openness (0.13 −0.27), and not consistently associated with agreeableness (-0.2 −0.16). Recently it has been suggested that overlap between agency and common measures of the big five might be substantial enough to extract reliable estimates of agency from the big five (Entringer et al. 2021). However, few empirical examples exist in the literature of direct comparisons between the narrow construct of agency and the big five.

Benefits of the big five model of personality are that the factors are identifiable cross-culturally, broadly capture many more narrowly defined facets, and are related to and predictive of many real-world outcomes of interest, such as health, well-being, academic achievement, and job performance (John et al. 2008; Roberts et al. 2007). Further, these associations are highly replicable (Beck and Jackson 2022; Soto 2019). Agency, however, is considered important in defining values, motivations, and alternative traits (overlapping but distinct from big five traits; for a review see Paulhus and Trapnell 2008). Agency is also related to life outcomes like career success (Abele 2003), other indicators of social status (Fiske et al. 2007; Wojciszke et al. 2011), and cross-culturally replicable. Paulhus and John (1998) note that cross-cultural and comprehensive analyses of human values, also, yield similar dimensions to agency-communion.

From a motivational point of view, generativity (i.e., the inner desire or social expectation to contribute something lasting to the world before death; McAdams & de St. Aubin, 1992) may be a logical link between agency and these outcomes. Highly agentic individuals tend to also express higher levels of generativity (Doerwald et al. 2021). Although generativity is also correlated with the big five (Blatný et al. 2019), generativity is often linked more closely with agency as they are both studied with respect to goals (Bakan 1966; McAdams and Logan 2004). In sum, based on past research agency should be distinct from the big five, have a large gender difference if it is related to masculinity, and be related to extraversion, neuroticism, conscientiousness, and generativity.

Behavior Genetic Studies of Agency

Genetic influences on broad personality domains are well-established. Meta-analytic estimates tend to converge on approximately 40–60% of the variance in personality being associated with genotypic variation (Vukasović and Bratko 2015), with little evidence of differential heritability across domains or levels of the trait hierarchy (Turkheimer et al. 2014). The heritability of various agentic, masculine, or dominant traits were estimated between 24 and 60% (see Supplement Table S1; Bailey et al. 2000; Bleidorn et al. 2010; Gottesman 1966; Hopwood et al. 2011; Lippa and Hershberger 1999; McCartney et al. 1990; Mitchell et al. 1989). To the best of our knowledge, no direct biometric estimates of agency have been reported with respect to agency as a personality trait, not agentic values or agentic goals. Each of the variables listed in Table S1 reflects past conceptual overlap with agency. For instance, masculinity

was measured using the Bem Sex Role Inventory and then later on the construct was relabeled to measure agency, while the scale questions remained consistent (Wiggins and Holzmuller 1981). Depending on the measures, the estimate for the heritability of agency or similar traits differs. Masculine measures were estimated to be 24–48% due to genetic influences, whereas dominance measures were estimated 42–60%. Because of the items in the current assessment of agency and previous maps of the interpersonal circumplex, we include dominance in the related traits (Wiggins 1979). Alternative conceptualizations of agency, like agentic goals showed an estimate of genetic influences less than the genetic influences of average personality traits (29% compared to 40–60%; Vukasović and Bratko 2015). As we described, agency is linked to assertiveness or dominance and measured using these adjectives (Abele et al. 2016; Lachman and Weaver 1997), and yet unaddressed is the heritability of agency or the validity of the current personality measure to be tapping into agency.

The Current Study

We sought to assess the psychometric and biometric features of a brief measure of agency available from the National Survey of Midlife Development in the United States (MIDUS; Brim et al. 1999) using non-twins, twins, and Milwaukee data. We analyzed gender differences, measurement invariance, associations with generativity, and relationship to the big five personality traits among unrelated individuals cross-sectionally (N=5,194). We then replicated results using the twin sample, providing a test of the reliability of these results, and we estimated the heritability of agency as well as its genetic and environmental overlap with the big five and generativity (N=1,914). We provided a robustness check using the MIDUS Milwaukee sample that was selected for larger proportions of racial diversity (N=389). In short, the present research aimed to understand how the brief assessment of agency conforms and deviates from theoretical expectations by addressing its relationships to gender, the big five, and generativity.

Methods

Participants

Non-Twin Sample

The first wave of the National Survey of Midlife Development in the United States (MIDUS 1) collected a general population sample from 1995 to 1996 yielding 7,108 participants. The collaborative project investigated patterns, predictors, and consequences of midlife development in terms of physical health, psychological well-being, and social responsibility. The full sample consisted of unrelated individuals, siblings, and twins (Brim et al. 1999). We used all available non-twins for the first set of phenotypic analyses, totaling 5,194 participants with a mean age of 46.93 years (range from 20 to 75, SD=13.27 years). The sample was 50.2% female and 49.8% male. The self-reported races of participants were White (N=4,016), Black and/or African American (255), Native American or Aleutian Islander (28), Asian or Pacific Islander (60), multiracial (40), and 106 identified as another race. Study variables were chosen for their expected associations with agency. For a negative control (i.e., showing not everything is correlated) we included BMI of the participants pre-calculated in the MIDUS data in the correlation matrices.

Twin Sample

Next, we used the twin sample to decompose variance in the phenotypes into genetic and environmental components. There was a total of 1,914 individuals (31 missing zygosity information), and the sample was 55.3% female and 44.7% male. The self-reported race of the participants was as follows: White (N=1,632), Black and/or African American (76), Native American or Aleutian Islander/Eskimo (11), multiracial (12), and 18 identified as another race. The twin sample had a mean age of 44.89 years (range from 25 to 75, SD=12.07 years).

Zygosity was determined via an eight-item self-report screener which asked about physical similarity. Although zygosity classification was not verified with genotyping, similar studies using the same items have found accuracy to be over 90% when confirmed via genotyping (Lykken et al. 1990). Triplets were included pairwise and downweighted to correct for the same individual appearing in multiple pairs (16 people in 4 family IDs). The resulting twin sample included 347 MZ pairs, 322 DZ pairs, and 252 DZOS pairs (total=921 pairs). The gender breakdown for same-sex pairs was 185 MZF, 162 MZM, 200 DZF, and 122 DZM.

Milwaukee Sample

In order to better examine health issues in minority populations, the Midlife in the United States study sampled Milwaukee, Wisconsin in areas of the city with high concentrations of African American residents. The correlations were reported as a robustness check of the generalizability of the largely White non-twins and twins. Sample details and correlations are in the Supplement (Table S2).

Measures

Personality Traits

Personality was measured by the Midlife Development Inventory (MIDI; Lachman and Weaver 1997). The MIDI personality inventory contains 30 adjectives that assess neuroticism, conscientiousness, extraversion, agreeableness, openness to experience, and agency. Each trait is measured by 4 to 7 items. Participants rated items on a 4-point scale indicating whether the adjective described them *not at all* to *a lot*. Means, standard deviations, and Cronbach's alpha reliability for the items and scales are reported in Table 1 and item-level in Table S3.

Loyola Generativity Scale- Contributions Domain

Participants completed six items rated on a 4-point scale from the Loyola Generativity Scale (McAdams & de St. Aubin, 1992) to measure the specific generativity domain of "contributions." Example items were: "Many people come to you for advice" and "You have had a good influence on the lives of many people." Psychometric properties of this scale are reported in Table S3.

Statistical Analyses

Analytic scripts are available at the OSF link: https://osf.io/qsj9u/. Analyses were conducted using R (R Core Team 2022) and the packages *lavaan*, *semTools*, *effsize*, *uMx*, and *psych* (Bates et al. 2019; Jorgensen et al. 2021; Revelle 2020; Rosseel 2012; Torchiano 2020). Given the large sample size and aims of the current study, we focus on effect size estimates and precision throughout. Thus, we included 99% confidence intervals rather than *p*-values for all phenotypic analyses. To correct for non-independence of observations due to the familial structure of the data, we used cluster-robust standard errors in the twin sample (McNeish and Harring 2017).

Measurement Invariance

Measurement invariance was examined between men and women by testing the patterns of thresholds, loadings, and intercepts for equivalence treating the data as categorical (Svetina et al. 2020; Wu and Estabrook 2016). The baseline (configural) model imposed no constraints across groups. Then stricter tests of equivalence followed: thresholds were first held equal, thresholds and loadings, thresholds and intercepts, and then all three parameters were held equal (Svetina et al. 2020). Threshold invariance for ordered, categorical data equates scales of latent responses. Specific

Table 1 Descriptive statistics for non-twin (N=5,194) and twin samples (N=1,914)

	Women (N=2,607; 1059)						Men (N=2,585; 855)					
	Non-twin			Twin			Non-twin			Twin		
	α	M	SD	α	M	SD	α	M	SD	α	M	SD
Agency	0.80	2.64	0.69	0.79	2.57	0.67	0.79	2.80	0.62	0.81	2.73	0.65
Extraversion	0.78	3.23	0.56	0.77	3.25	0.56	0.77	3.15	0.56	0.79	3.19	0.57
Agreeableness	0.77	3.61	0.42	0.78	3.63	0.41	0.81	3.34	0.53	0.81	3.38	0.51
Conscientiousness	0.53	3.46	0.44	0.54	3.49	0.44	0.59	3.36	0.46	0.55	3.38	0.42
Neuroticism	0.76	2.31	0.68	0.76	2.30	0.67	0.73	2.16	0.64	0.76	2.19	0.67
Openness	0.78	2.99	0.55	0.78	2.95	0.55	0.77	3.08	0.50	0.77	2.99	0.51
Generativity	0.84	2.86	0.63	0.84	2.85	0.62	0.84	2.80	0.64	0.85	2.78	0.63

assumptions are made when each set of parameters are constrained, each sequential model is based on finding acceptable fit based on scaled statistics in the prior constraints. The final model constraining thresholds, loadings, and intercepts, ensures a comparison of the factor means and variances can be made equivalent to invariance of loadings and intercepts for continuous data (Wu and Estabrook 2016). The model was first identified using delta parameterization (Wu and Estabrook 2016). We used standard cutoffs for determining whether the assumptions of measurement invariance held (i.e., $\Delta CFI \leq 0.01$; Cheung and Rensvold 2002). Model comparisons indicated that factor scaling was consistent across gender (see Table S4). After establishing measurement invariance, subsequent analyses were carried out with the mean scores (Widaman and Revelle 2022).

Phenotypic Analyses

We estimated bivariate correlations and multiple regression between agency and the other phenotypes cross-sectionally. To examine gender differences in the agency score, we estimated standardized mean differences via Cohen's *d* (Torchiano 2020) and visualized item responses (Figures S1-S3). We calculated Pearson correlation coefficients using pairwise complete observations. Multivariate associations between agency and all big five traits simultaneously were estimated in a linear regression analysis. Clustered robust standard errors were included for the twin sample. Cross-trait cross-twin correlation matrices for MZ same-sex, DZ same-sex, and DZ opposite-sex twins were computed after data was transformed to wide format (one twin pair per row; provided in Table S5).

Behavior Genetic Analyses

We decomposed the variance in each phenotype using the genetically informative twin subsample (Neale and Cardon 1992). Because MZ twins are more genetically similar than DZ twins, larger MZ twin correlations compared to DZ twin correlations indicate additive genetic influences (A). If twins are more psychologically similar than would be expected due to additive genetic influences alone, this result indicates that shared environmental factors (C) also influence the phenotype. However, if MZ twin similarity is more than double DZ twin similarity, this result indicates that dominant genetic influences (D) are plausible. Dominance influences subsume non-additive genetic influences. The classical twin design does not provide sufficient information to identify C and D simultaneously and therefore were not estimated in the same model. Finally, unless MZ twins are psychologically identical, nonshared environmental influences (E) lead to differences between twins.

We formalized the assumptions of this model in a structural equation modeling framework where variance in the phenotypes was decomposed into A, C, D, and E factors, depending on the pattern of twin correlations. For MZ twins, the correlation between factors representing genetic and shared environmental influences was fixed to 1, reflecting that MZ twins share nearly identical genotypes and shared environmental influences. For DZ twins, the correlation between the A factors was fixed to 0.5, reflecting the assumption that DZ twins share, on average, 50% of segregating genetic material. The correlation between D factors was fixed to 0.25, reflecting the probability that the twins share the dominant allele. For all twin pairs, the correlation between E factors was fixed to 0 due to these effects being individual-specific. Multivariate extensions of these models are premised on the same logic and allow for decomposing covariance between phenotypes into genetic and environmental components. Genetic modeling controlled for age and gender covariates, which is standard procedure for genetic analyses (McGue and Bouchard 1984).

Using these behavior genetic techniques, we estimated a series of univariate models to identify the best-fitting set of variance components to represent each phenotype (see Table S5 for cross-twin cross-trait correlations). These analyses indicate the extent to which genetic and environmental influences contribute to agency. Then, we estimated bivariate models to decompose the covariance between agency and the other phenotypes. These analyses indicate the extent to which genetic and environmental influences link agency with the big five and generativity. We used a multivariate extension of these models, the behavior genetic analogue of multiple regression, to estimate associations between big five and agency controlling for the other included phenotypes. In contrast to regression, the order in which phenotypes are entered into the model impacts interpretation. We specified phenotypes with the weakest association with agency to take precedence in the model to limit convergence issues.

Model Fit

Model fit can be assessed using the −2 log likelihood (–2LL), which is $\chi 2$ distributed. Nested models were compared using likelihood ratio tests (Δ–2LL), with a significant increase in −2LL indicating a deterioration of model fit. Genetic models are also typically compared using the Akaike Information Criterion (AIC), a goodness-of-fit measure based on model fit and parsimony (AIC = −2LL minus two times the degrees of freedom). A lower AIC indicated a better model fit. Genetic analyses were conducted using *uMX* package wrapper functions based on *OpenMx* statistical software (Bates et al. 2019; Boker et al. 2022; Hunter

2018; Neale et al. 2016; Pritikin et al. 2015) run within R using a maximum likelihood estimation procedure.

Results

After establishing measurement invariance, we calculated descriptive statistics split by gender for the study variables (Table 1) and bivariate correlations (Table 2). We split by gender because of our interest in parsing the gendered nature (or the lack) of trait agency. Item-level descriptive statistics are reported in Table S3. Because descriptive information concerning the big five have been reported elsewhere using these data (Graham et al. 2020; Olaru and Allemand 2022), instead we focus on agency and its links to generativity and the big five.

How Does Gender, Big Five, and Generativity Relate To Agency?

Men reported modestly higher levels of agency than women in the non-twin (d = -0.24, 99%CI [-0.317, -0.162]) and twin samples (d = -0.24, 99%CI [-0.368, -0.116]; see Figure S1-S3 for distributions and item information curves). Women were modestly more variable in agency relative to men. Despite typical descriptions of agency centering on masculinity, distributions of agency were largely overlapping.

Consistent with expectations, agency was moderately-to-strongly correlated with extraversion and moderately correlated with generativity (Table 2). Openness was also moderately-to-strongly correlated with agency. Agentic individuals reported being outgoing, active, imaginative, creative, and desiring to leave a mark on the world to a greater extent than less agentic individuals. Generative individuals also reported higher levels of extraversion and openness, similar to agentic individuals. In contrast, generative individuals reported higher levels of agreeableness. This association was much weaker for agency, indicating that being warm, caring, and sympathetic are personological distinguishing factors between agency and generativity. Associations with the other personality dimensions were more modest. Age was uncorrelated with agency (-0.012).

Multiple regression results (Table 3) supported agreeableness as playing a differential role for agency. Extraversion and openness retained moderate, positive associations with agency even when controlling for the other big five. For agency, agreeableness was estimated to have a negative association when controlling for the rest of the big five. Put differently, among individuals with similar levels of extraversion and openness, more agreeable individuals would be expected to have lower levels of agency. At the zero-order level, this negative association was masked due to the positive associations among agreeableness, extraversion, and openness (Figure S4). Overall, approximately 41–46% of the variance in agency was associated with the big five leaving 54–59% of the variance in agency unique to trait agency. Given the brief assessment of personality adjectives that included agency, agreeableness (double-labeled as communion), and the rest of the big five, these results indicated uniqueness of trait agency from the five factor model of personality.

How Does the Overlap between Agency and Related Phenotypes Decompose To Genetic and Environmental Influences?

The univariate results including the reduced models are shown in Table S6. The full ACE model yielded an estimate of 2.5% shared environmental influences; the AE model did not show a decrement in fit compared to the full model and had the lowest AIC among the tested models (ΔAIC = -1.999). Thus, the results for the best model for agency were as follows: The standardized squared path loadings for additive genetic influences (a^2) accounted for 44.4% (se = 0.038), and nonshared environmental influences (e^2) accounted for 55.6% (se = 0.027) of the variance in agency. These estimates align with the average heritability of personality traits (Vukasović and Bratko 2015) and were larger than some estimates of agentic goals or masculinity (see Table S1).

Next, the overlapping influences with agency per trait are displayed along with the residual influences of agency in Table 4. Whereas agency did not show nonadditive genetic influences, most other variables did (i.e., generativity, extraversion, agreeableness, conscientiousness, and neuroticism). Full bivariate model fit results from ACE, ADE, and AE models are reported in Table S11; here, we report the estimates derived from the best-fitting AE models only. The phenotypic associations with agency in a non-twin sample mapped closely onto the pattern of associations in twins. Openness and extraversion were the strongest correlates in both samples. Once we decompose the covariation into additive genetic and nonshared environmental components, only openness and extraversion accounted for more than a quarter of the variance in agency while the remaining traits each only accounted for less than 20% of the variance of agency. Specifically, extraversion showed substantial genetic overlap with agency while openness and generativity had 14–17% shared genetic influences with agency. Common across all the bivariate associations was that the remaining influences on agency were largely due to environment, or the unique experiences not shared between twins raised together.

Table 2 Zero-order correlation matrix from the non-twin (upper triangle) and twin (lower triangle) MIDUS wave 1 samples

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	--	0.104	−0.008	−0.031	0.079	0.053	−0.144	−0.078	−0.012
99% CI		(0.065, 0.143)	(-0.047, 0.031)	(-0.069, 0.008)	(0.040, 0.117)	(0.015, 0.092)	(-0.182, −0.106)	(-0.116, −0.039)	(-0.051, 0.026)
2. BMI	0.092		−0.005	−0.040	0.011	−0.128	−0.010	−0.063	0.035
99% CI	(0.030, 0.154)	--	(-0.045, 0.034)	(-0.079, 0.000)	(-0.028, 0.051)	(-0.167, −0.089)	(-0.050, 0.029)	(-0.10, −0.023)	(-0.005, 0.074)
3. Generativity	0.021	−0.028	--	**.390**	**.330**	0.259	−0.138	**.446**	**.358**
99% CI	(-0.041, 0.083)	(-0.091, 0.036)		(0.357, 0.423)	(0.295, 0.365)	(0.222, 0.295)	(-0.176, −0.099)	(0.414, 0.476)	(0.324, 0.392)
4. Extraversion	0.021	−0.107	**.398**	--	**.529**	0.268	−0.114	**.515**	**.509**
99% CI	(-0.041, 0.082)	(-0.169, −0.044)	(0.344, 0.449)		(0.501, 0.557)	(0.232, 0.304)	(-0.182, −0.106)	(0.486, 0.543)	(0.479, 0.537)
5. Agreeable-ness	0.055	−0.054	**.337**	**.516**	--	0.289	−0.041	**.356**	0.097
99% CI	(-0.007, 0.117)	(-0.117, 0.009)	(0.280, 0.391)	(0.469, 0.560)		(0.253, 0.324)	(-0.080, −0.003)	(0.321, 0.389)	(0.058, 0.135)
6. Conscientious-ness	−0.028	−0.128	0.234	0.275	0.262	--	−0.187	0.261	0.239
99% CI	(-0.090, 0.034)	(-0.190, −0.065)	(0.174, 0.293)	(0.217, 0.332)	(0.203, 0.319)		(-0.225, −0.150)	(0.225, 0.297)	(0.202, 0.276)
7. Neuroticism	−0.153	0.049	−0.117	−0.172	−0.038	−0.219	--	−0.149	−0.083
99% CI	(-0.213, −0.092)	(-0.014, 0.112)	(-0.178, −0.054)	(-0.231, −0.110)	(-0.100, 0.024)	(-0.277, −0.159)		(-0.187, −0.111)	(-0.122, −0.044)
8. Openness to experience	−0.055	−0.086	**.432**	**.519**	**.346**	**.314**	−0.193	--	**.516**
99% CI	(-0.117, 0.007)	(-0.148, −0.022)	(0.379, 0.482)	(0.471, 0.563)	(0.290, 0.400)	(0.256, 0.369)	(-0.253, −0.133)		(0.487, 0.544)
9. Agency	−0.017	0.008	**.349**	**.549**	0.082	0.252	−0.106	**.514**	--
99% CI	(-0.079, 0.046)	(-0.056, 0.071)	(0.292, 0.403)	(0.504, 0.592)	(0.020, 0.144)	(0.193, 0.310)	(-0.167, −0.044)	(0.466, 0.559)	

Note Correlations greater than 0.30 are bolded

Table 3 Multiple regression results for associations between agency and the big five factors in the non-twin and twin samples

	Non-twin B	se	99% CI	Twin B	se	99% CI
Intercept	-0.001	0.012	[-0.062, 0.061]	-0.002	0.018	[-0.094, 0.091]
Extraversion	0.452	0.015	[0.375, 0.530]	0.530	0.024	[0.407, 0.654]
Agreeableness	-0.302	0.014	[-0.374, -0.230]	-0.330	0.021	[-0.439, -0.222]
Conscientiousness	0.114	0.013	[0.053, 0.176]	0.097	0.020	[-0.006, 0.200]
Neuroticism	0.047	0.012	[-0.015, 0.109]	0.061	0.019	[-0.036, 0.159]
Openness to experience	0.373	0.014	[0.0301, 0.445]	0.339	0.022	[0.226, 0.452]
R^2	0.415			0.459		

Table 4 The standardized bivariate decomposition estimates from the best-fitting models (AE). Shared influences (a^2 and e^2) and unique influences (a^2 and e^2) of agency are shown. Bolded estimates do not include zero in the 99% confidence interval

	Influences shared with agency		Residual influences of agency	
Variable	a^2 [99%CI]	e^2	a^2	e^2
Neuroticism	0.019 [-0.233, 0.271]	0.001 [-0.200, 0.202]	**0.426 [0.230, 0.622]**	**0.554 [0.415, 0.693]**
Agreeableness	0.026 [-0.324, 0.376]	0.005 [-0.191, 0.201]	**0.417 [0.211, 0.623]**	**0.552 [0.413, 0.691]**
Conscientiousness	0.072 [-0.196, 0.340]	0.016 [-0.185, 0.217]	**0.372 [0.171, 0.573]**	**0.540 [0.406, 0.674]**
Generativity	0.143 [-0.166, 0.452]	0.038 [-0.158, 0.234]	**0.303 [0.071, 0.535]**	**0.516 [0.382, 0.650]**
Openness	0.174 [-0.084, 0.432]	0.109 [-0.076, 0.294]	**0.272 [0.087, 0.457]**	**0.445 [0.321, 0.569]**
Extraversion	**0.253 [0.006, 0.500]**	0.115 [-0.070, 0.300]	0.186 [-0.041, 0.413]	**0.446 [0.322, 0.570]**

For the multivariate genetic model, the order of input for the traits were: Neuroticism, agreeableness, conscientiousness, extraversion, openness then agency following the bivariate results. The unique genetic and environmental influences for the personality traits, including overlap among personality traits, are reported along with model fit results in the Supplement (Table S8-S11). The reduced model, AE, was the best-fitting model (AIC = 3632.08, *-2LL* = 18254.08). The results are shown in Fig. 1. The unique influences of agency, after accounting for the big five traits, were 6.6% additive genetic effects and 49.5% nonshared environmental effects. The total shared effects were broken down into 37.4% genetic effects and 16.3% environmental effects from the big five traits. Genetic variance in the big five accounted for 85% of the variance in the genetic influences of agency. Our results align with a prior study of agentic goals where the big five accounted for 41% of the genetic effects at time one and 56% of the genetic effects at time two, and the most strongly overlapping traits were extraversion and openness (Bleidorn et al. 2010).

Discussion

The current undertaking was largely descriptive prompted by the MIDI personality scale overlapping two individually powerful personality taxonomies—agency-communion dimensions and big five traits, and an interest in unraveling what it means to approach the world with self-focused dominance (i.e., high agency). The psychology literature has not distinguished measures of agency-communion and masculinity-femininity, and indeed often uses the labels interchangeably for the same measures. Present analyses found a small average gender difference (d = -0.24) in agency. The difference between men and women is much less than would be expected from a trait that has been linked explicitly with masculinity in the past, and smaller than a recent meta-analysis which found agency (measured by masculinity) to be higher in men than women (Hedge's g = 0.40; Hsu et al. 2021). Agency was strongly related to the big five personality traits of openness to experience and extraversion, as well as strongly related to the motive to be generative—contribute to future generations and influence people. In multiple regressions, our results across two samples show the big five accounted for a large portion of the variance in agency (41–46%) using abbreviated scales.

Associations at the phenotypic level extended to the genetic level, showing extraversion accounted for 36.8% (11.5% nonshared environmental influences) of the variation in agency, openness overlapped with 28.3% (10.9% nonshared environmental influences), and generativity accounted for 18.1% (3.8% nonshared environmental influences). Altogether, the multivariate biometric model, which accounted for all the big five traits, left 46.1% (39.5% environment) of the variance uniquely attributable to agency. It is expected that a portion of the unique environment is measurement error that is more likely random and not common method bias.

A meaningful distinction in the personality and behavior genetic literature has been made between dispositional traits and characteristic adaptations. The big five are understood to be dispositional traits which underlie patterns of thinking,

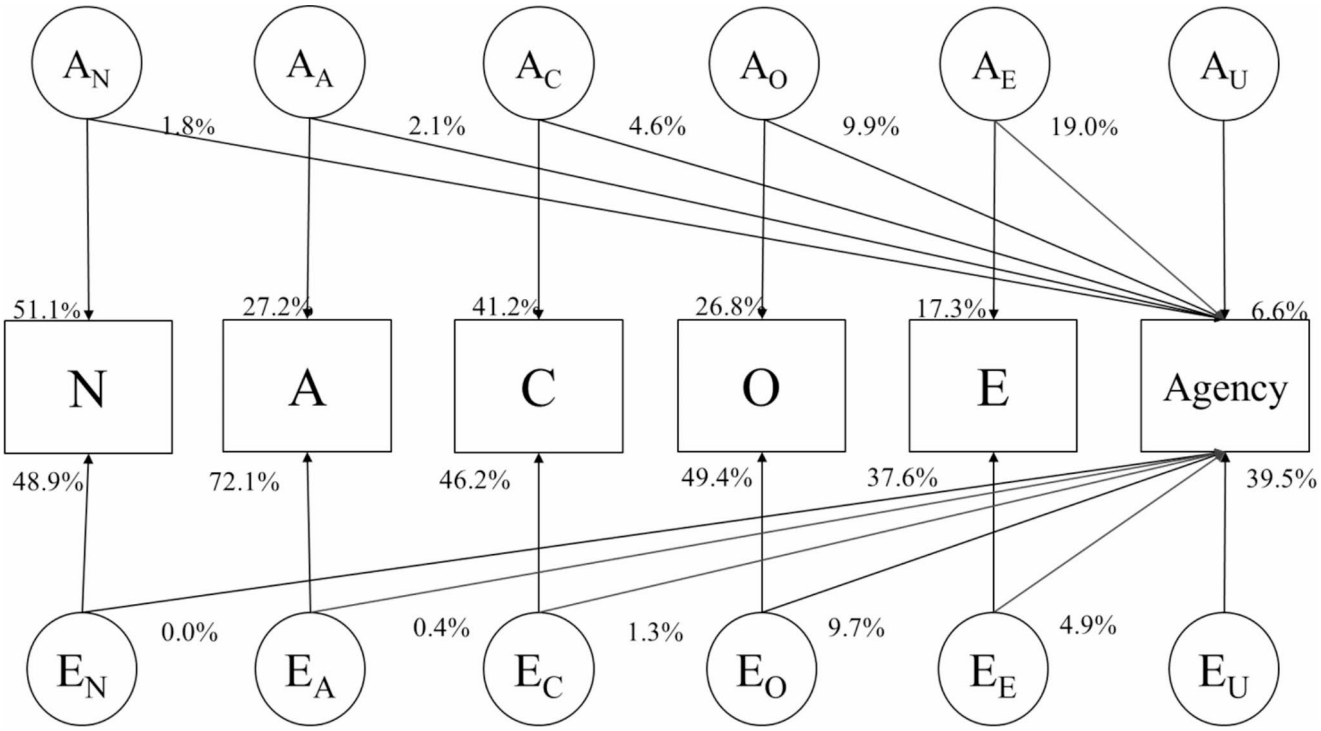

Fig. 1 Multivariate biometric decomposition model displaying the additive genetic and nonshared environmental contributions to the covariance between big five traits (E, A, C, N, and O) and agency. A, additive genetic factors; E, nonshared environmental factors. Latent factor subscripts denote the phenotype its shared with or "u" the unique/residual influences of agency. Cross-paths among big five trait A and E latent factors are dropped for simplicity

feeling, and behaving across situations and contexts. Characteristic adaptations are context-sensitive descriptions of the person which include the domains of goals, interests, morality, values, and self-schemas. As stated previously, the heritability of various masculine, or dominant, constructs have been estimated between 24 and 60% (see Supplement Table S1; Bailey et al. 2000; Bleidorn et al. 2010; Gottesman 1966; Hopwood et al. 2011; Lippa and Hershberger 1999; McCartney et al. 1990; Mitchell et al. 1989). In recent research, Kandler and colleagues (2022) performed biometric decompositions of 50 presumed dispositional traits and 43 presumed characteristic adaptations. The lower end of the masculine or dominant estimates was similar to what Kandler et al. (2022) found for characteristic adaptations, with the higher end more consistent with results for dispositional traits. This ambiguity leaves unaddressed whether agency is better thought of as a characteristic adaptation or dispositional trait. Bleidorn et al. (2010) studied agency goals and found the genetic variance of the construct to be 29% and 33% at times 1 and 2, respectively. In MIDUS, the construct for agency is measured by a trait-like list of adjectives alongside the big five traits which are acknowledged to be dispositional traits and not characteristic adaptations. However, the estimated variance components from twin models of agency in the present study suggest 44.4% of the variance was attributable to genetic influences and 55.6% to nonshared environmental influences moderately supportive of a characteristic adaptation. Despite trait-like wording of items, these estimates match the classic twin model results of goals, broadly, from Kandler et al. (2022). The results from our study for the variance of generativity, a clear-cut characteristic adaptation, was estimated 32.4% due to genetic contribution, so overall we saw a close alignment with our selected variables and Kandler and colleagues' (2022) findings.

Furthermore, the large genetic variance overlap between the big five and agency further supports a characteristic adaptation definition of agency (Kandler and Rauthmann 2022). The *genetic pathway criterion* from Kandler and Rauthmann (2022) suggests that the genetic variance of traits should account for the genetic variance of characteristic adaptations, defined as person characteristics in-context, or state-like constructs. Bleidorn et al. (2010) found only 41–56% of the genetic variance agency to be accounted for the by the big five, we found that 85% of the genetic variance of agency was accounted for by the big five. In contrast, Bleidorn et al. (2010) and the present study found 25% and 29% of the environmental variance to be accounted for by the big five, respectively. One explanation for the difference in shared genetic variance was in the measurement of agency using a list of trait-like adjectives rather than a more narrow focus on goals. Altogether, these results suggest that

agency should be thought of primarily as a characteristic adaptation which may be particular to life circumstances and sensitive to the context by which it is studied. However, framing, context and measurement may affect the pattern of agency results and how it fits in relation to dispositional traits which underlie patterns of thinking, feeling, and behaving across situations and contexts.

A characteristic adaptation would suggest agency should be measured context-specific rather than treated as a universal dimension that may remain consistent across social situations. Given lacking definitions in the field for agency, we hope these results will help provide some clarity to current debates on agency measurement and construct definitions (Cavazzoni et al. 2022).

According to the Cybernetic Big Five Theory (DeYoung 2015), personality traits may have developmental influences on characteristic adaptations like agency. Other theories agree that there is some trait hierarchy by which personality traits, like the big five, are relatively stable and may relate to characteristic adaptations which guide behaviors and responses in a given situation (McCrae and Sutin 2018). If traits and characteristic adaptations are organized within one hierarchy, we find support that additive genetic influences may be shared between traits and adaptations and may help guide *how* specific traits and adaptations are organized. In our case, the genetic overlap between agency and extraversion and the genetic and environmental overlap between agency and openness could be informative to the hierarchical structure. Longitudinal research should be done in the future to parse out the direction of influences in order to test the proposed relation by multiple big five theories (DeYoung 2015; Kandler and Rauthmann 2022; McCrae and Sutin 2018).

Our current evidence supports the psychometric properties of the brief measure of agency in the MIDI personality instrument that aligns with work on agentic narratives (McAdams et al. 1996; McAdams & de St. Aubin, 1992) and agency-communion circumplex (Wiggins 1979; Wiggins and Trapnell 1996). The present results altogether suggest agency is tapping into information distinct from the current big five traits using the MIDI personality inventory. The associations with the big five and generativity provide some support for the validity of the measure of agency. In fact, the results show a clear distinction between a largely gendered construct, like masculinity, and what it means to be agentic. Yet, a primary focus on the development of construct definitions of agency considers the role of gender (Cavazzoni et al. 2022), which we argue may be important when the cultural context of society and time are accounted for. Finally, this was the largest empirical estimation of the heritability of a measure of trait agency.

Limitations and Future Directions

Our study was the first empirical investigation of the heritability of agency in MIDUS. Only one recent study was found on the genetic and environmental correlates between personality and loneliness that included agency (Freilich et al. 2022). However, our focus was on the correlates of agency and they were interested in loneliness and personality correlates. One past study was found to examine agency in MIDUS longitudinally with well-being (Haas and vanDellen 2020) but not among other personality traits.

One limitation was the available measures of agency and the big five. The MIDI personality scales are an extra short personality inventory that is not often used by personality researchers. Because of its inclusion in a wide-ranging population study, the MIDI inventory necessarily values brevity over breadth; therefore, the question of whether agency encompasses specific facets under such traits as extraversion and openness or whether agency explains the differences between men and women on the big five traits remains unanswered. The current measure, also, lacked a distinct communion scale. Measurement error was not fully accounted for by using average scores; however, our analyses suggest that even when using a measure not attenuated for measurement error, there is unique variance attributable to agency. That being said, even the brief measure of agency showed results that aligned with expectations in terms of heritability and correlates.

The second limitation was lack of generalizability across cohorts, race, and gender diverse people. The current study, which used cohorts who were born between 1920 and 1975, was not equipped to test for cohort effects in younger cohorts or those born nearer the turn of the 21st century. Whether gender differences in agency remain stable over generations and whether the pattern of associations persist from one generation to the next are two questions that would be useful to test with more recent cohorts compared to older cohorts. Next, although the sample was collected to be population representative, racial diversity was still insufficient to provide appropriate sample sizes to specifically test the equality of effect sizes across racial identities or ethnicities. The Milwaukee sample provided a slight indication that the phenotypic correlations were robust across samples. Finally, there were no gender diverse people included in MIDUS by its reporting of respondent's sex as "male," "female," or missing. Not even allowing a third option leads to the explicit exclusion of certain groups, and based on question wording assesses biological sex rather than gender identity.

Future Research

To understand the relationships of agency and related constructs better, future research should examine a more robust measure of agency, and ideally communion, in longitudinal data with larger diversity of sampled race, ethnicity, and gender in recent cohorts. Longitudinal studies of agency are lacking (Cavazzoni et al. 2022) and behavior genetic modeling may provide insight into the expected patterns of change over time. They may also address whether we find that as people age, agency may become more dispositional in its manifestation due to the more limited social roles or loss avoidance goal-setting in late adulthood (Freund 2024). Refined measurement of agency-communion values shows promise in motives research (e.g., Conroy and Green 2020), political psychology (e.g., Beattie et al. 2019), and social isolation research (e.g., Helm et al. 2018). Agency-communion traits similarly have been illuminating for stereotyping (e.g., Klysing et al. 2021), interpersonal perception (e.g., Abele and Yzerbyt 2021), and hiring practices/discrimination and workplace behaviors research (e.g., Chalmers 2021; Kahalon et al. 2021). This being only a small selection of the current research underway with agency-communion.

Conclusions

Our studies serve as an evaluation of the brief measure of agency and its reliability, validity, and heritability. Agency was most strongly correlated with openness to experience, extraversion, and generativity. Across both samples, we observed a consistent but small gender difference in agency, which was not accounted for by differences in measurement properties. In the twin sample, agency fit criteria defined by Kandler and colleagues (2022) and Kandler and Rauthmann (2022) to be considered a characteristic adaptation. This finding is informative for the genetic structure and hierarchy of dispositional traits, like the big five, and characteristic adaptations, like generativity and agency. We have shown these associations in a genetically-informative, large, national U.S. sample. We suggest these results be replicated in unique samples with more context-sensitive measures of agency-communion (e.g., Abele et al. 2016) considerate of all gender identities. We should consider the ramifications of the explicit historical links drawn between masculinity and agency and how that affects biases, prejudices, and personality ratings. The current brief measure of agency did not appear to have gender biases in the assessment and yet still functioned as expected.

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Data Availability Data from the MIDUS study is available to the public through ICSPR (http://midus.wisc.edu/data/index.php). We do not provide cleaned data to encourage downloading directly from MIDUS (per their guidelines) but we provided scripts to recreate the results. MIDUS Milwaukee sample is protected behind a request for access.

Code Availability Code is available on OSF (https://osf.io/qsj9u/?view_only=5794f5d6b414474a953000337de38b95https://osf.io/qsj9u/).

Declarations

Ethical Approval Ethic approval of this study was waived by the IRB at the University of Illinois at Urbana-Champaign (#21263) for being classified as not human subjects research.

Consent to Participate Not applicable.

Consent for Publication Not applicable.

Competing Interests The authors declare no competing interests.

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