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The intersection of individual differences, personality variation, & military service: A twin comparison design

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ABSTRACT

In societies where military service is voluntary multiple factors are likely to affect the decision to enlist. Past research has produced evidence that a handful of personality and social factors seem to predict service in the military. However, recent quantitative genetic research has illustrated that enlistment in the military appears to be partially heritable and thus past research is potentially subject to genetic confounding. To assess the extent to which genetic confounding exists, the current study examined a wide range of individual-level factors using a subsample of twins (n = 1,232) from the restricted-use version of the National Longitudinal Study of Adolescent to Adult Health. The results of a series of longitudinal twin comparison models, which control for the latent sources of influence that cluster within families (i.e., shared genetic and family factors), illustrated generally null findings. However, individuals with higher scores on measures of extraversion and the general factor of personality were more likely to enlist in the military, after correction for familial confounding. Nonetheless, the overall results suggest that familial confounding should be a methodological concern in this area of research, and future work is encouraged to employ genetically informed methodologies in assessments of predictors of military enlistment.

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What is the public significance of this article?—To test whether personality traits affect the decision to voluntarily enlist in the American Armed Forces the present study used a twin-based design to control for genetic and non-genetic factors shared within families that could influence enlistment. Overall, the results illustrated that when these shared factors are taken into account a wide range of personality traits and individual characteristics (e.g., religiousness, social support, grades in school) did not predict enlistment into the military. The study indicates that genetic and non-genetic factors shared within families are most likely to predict military enlistment.

The topic of occupational choice has been of interest to psychologists for decades, and there is a wealth of research pertaining to why certain individuals pick certain careers (Forer, 1953). While a range of social variables have been investigated (including family environments, socioeconomic status, among others), scholars studying the topic of career choice have long recognized the importance of individual-level selection factors in decisions about which occupational field to enter. Over six decades ago, for example, Forer (1953, p. 361) observed that:

> There is growing awareness among vocational counselors as well as among clinical psychologists that the selection of one's occupation is not basically a fortuitious [sic] process. While the limits and pressures of uncontrollable external circumstances play a part, the general psychological factors listed below are of major causal importance …
>
> Occupational choice, the specific occupation chosen or the fact of lack of preference, is an expression of basic personality organization and can and should satisfy basic needs.

To be sure, cultural and socio-historical factors would be expected to influence career availability and choice at a given point in history. Yet, to the extent that individual-level traits inform human decision-making at all, one would predict that they should explain some variance in the decisions about job and career choices (Fiedler, Oltmanns, & Turkheimer, 2004). Indeed, several studies exist revealing personality and temperamental correlates for selection into a range of career fields (Jackson, Thoemmes, Jonkmann, Lüdtke, & Trautwein, 2012).

Within the broad arena of occupational research mentioned above, choices about military enlistment have been of interest to social scientists for some time

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(Beaver, Barnes, Schwartz, & Boutwell, 2015; Jackson et al., 2012; Miles & Haider-Markel, 2018). Since the early 1970s service in the armed forces in the United States has been completely voluntary in nature. In scenarios where military conscription exists, however, variation in military service may often reflect factors beyond the realm of personality and temperament (Jackson et al., 2012). For example, individuals possessing various medical conditions that preclude them from active service, or gender restrictions that would not permit female service, would explain variation more fully than personality or temperamental traits. However, in cases where enlistment is voluntary, and largely open to anyone, one may expect that variation in decisions to enlist are more strongly attributable to individual-level factors, including personality traits and cognitive abilities (Beaver et al., 2015; Jackson et al., 2012).

Along these lines, there is evidence suggesting that variation across classic big five personality traits seems to play a role in the selection process. Jackson et al. (2012), using a longitudinal sample of roughly 1,200 German males, found that high school students scoring lower on measures of agreeableness, neuroticism, and openness (to experience) were more likely to enlist for military service later in life, compared to participants scoring higher across those items. More recently, using data from approximately 1,200 American respondents – sampled as part of national survey completed by Clear Voice Research – Miles and Haider-Markel (2018) further examined the possibility that personality variation might correlate with decisions about military service. While no association existed between military service and extraversion, a negative association emerged for agreeableness and military service, as well as a positive association for emotional stability and participation in the armed forces.

Familial confounding & military service

A challenge that emerges in prior research on this topic, of course, involves the difficulties in drawing causal inferences about correlations between personality factors and military involvement. Setting aside the possibility that military service might also influence personality variation once an individual enters the military (thus reversing the causal arrow; see Jackson et al., 2012), even studies that preserve time order between personality and military service remain vulnerable to forms of familial confounding that is both genetic and environmental in origin (Barnes et al., 2014a). To understand why this is the case, it is important to first highlight prior evidence suggesting that variation across all complex human traits, including personality traits, is partly heritable (Polderman et al., 2015). Additionally, variation in military service decisions is also moderately to strongly heritable. In their analysis of data from the National Longitudinal Study of Adolescent to Adult Health (Add Health; the same data included herein), Beaver et al. (2015) reported evidence that roughly 82% of the variance in enlistment was attributable to genetic differences in the population, with the unique environment (and measurement error) explaining the remaining variance.

Similarly, Miles and Haider-Markel (2018) – who analyzed data from the MIDUS study, a sample of young adult and middle-aged American respondents – observed that approximately 62% of the variance in military service was explained by genetic factors, with the nonshared environment explaining the remaining portion of variance. Unlike Beaver et al. (2015), however, Miles and Haider-Markel (2018) expanded their work to also examine whether personality factors influencing military service might correlate (at a genetic level) with military service. Put differently, they tested whether overlapping genetic influences might exist for personality and occupation. While most of the genetic correlations tested were zero, a significant correlation did emerge between military service and emotional stability.

The current study

The research mentioned above highlights two specific avenues that need to be further examined. First, additional individual level constructs – including traits such as self-control, intelligence, and self-esteem – warrant investigation regarding possible influences on military service. Each trait mentioned is associated with a variety of prosocial and antisocial behaviors, general decision-making, and occupational choices (Gottfredson, 2004), yet little is known about their associations with military service. Second, while Miles and Haider-Markel (2018) provided evidence of a genetic correlation, they did not test whether personality factors continued to exert some influence on military service after familial confounds had been taken into account (see Turkheimer & Harden, 2014). As a result, we examine these issues using a subsample of twins drawn from the restricted data from the Add Health and a twin comparison design.

Method

Participants

Data for the current study were drawn from waves one, two, and four of the Add Health study. Please see Harris, Halpern, Smolen, and Haberstick (2006) for detail regarding the sampling procedures.[1] Briefly, the Add

Health is a prospective study that is comprised of a nationally representative sample of students in America who were enrolled in grades 7 through 12. The first wave, conducted in 1994 and 1995, and the second wave, conducted in 1996, of data included both in-school and in-home questionnaires tapping a wide range of topics relevant to adolescence. The third wave of data was conducted in 2001 and 2002 while the fourth wave of data took place in 2007 and 2008. The questionnaires employed during the third and fourth waves differed considerably from the initial two waves as the respondents were in their early-to-late twenties (Wave 3) and then mid-twenties to early thirties (Wave 4). Thus, respondents answered a variety of questions relating to adult life such as drug and alcohol use, family life, educational history, employment, among others (Harris et al., 2006). A fifth wave of data collection was recently released.

During the first wave of data collection specific sampling procedures took place to increase the inclusion of kinship dyads. Consequently, twins, siblings, and other kinships (e.g., cousins) of the original targeted respondents were guaranteed enrollment in the sample (Harris et al., 2006). This oversampling procedure resulted in the inclusion of over 3,000 kinship pairs within which were nested 307 monozygotic (MZ) and 452 dizygotic (DZ) twin pairs (zygosity was assessed using genotype data; see Harris et al., 2006). Data for the current study was limited to MZ and DZ twin pairs who provided a valid response (i.e., non-missing) to a military enlistment question (see below). Consequently, the analytical sample is comprised of 482 MZ twins (241 pairs) and 750 DZ twins (375 pairs), for a total of n = 1,232 respondents (616 twin pairs). Both same-sex (410 respondents, 205 pairs) and different-sex (340 respondents, 170 pairs) DZ twins were included in the analytical sample to boost sample size. Note that the multivariate analyses (see below) included a control for different-sex DZ pairs.

Measures

Outcome measure

Military enlistment. During the Wave 4 interviews, respondents were asked the following question "*Have you ever been in the military?*". This measure serves as the dependent variable in the current study and was coded dichotomously such that 0 = no (no military service) and 1 = yes (military service).

Individual differences during adolescence

The selection of measures of individual differences during adolescence was guided primarily by the constructs examined in the prior literature (e.g., Miles & Haider-Markel, 2018) and availability in the Add Health data. A complete list of the individual items comprising the various measures is provided in the supplemental materials.

Low self-control. Numerous scholars have illustrated the wide-ranging influence that impulse control has on a variety of components of the lifecourse, including employment (e.g., Moffitt et al., 2011). Prior research indicates that thrill- and adventure-seeking may also contribute to the decision to enlist in the military (Eighmey, 2006). Consequently, a measure tapping aspects of the latent low self-control construct put forth by Gottfredson and Hirschi (1990) was created based on 27 items from Wave 1 (of which 4 items were from the parent questionnaire) and 20 items from Wave 2. In line with prior literature (e.g., Nedelec, Park, & Silver, 2016) the 47 items were standardized, summed, and then divided by the number of non-missing items included in the index to form an average level of low self-control during adolescence (α =.82; where higher values indicated lower levels of self-control). Following prior literature using the Add Health data (e.g., Nedelec et al., 2016) we employed the alpha command in Stata and required a minimum of 50% of the constituent items to be non-missing for an index to be created for a single respondent. To reduce missingness, this procedure was employed in creating all the individual differences in adolescence measures (except IQ, which is only available at Wave 1). Note that all Cronbach's alphas displayed in the text refer to the final analytical sample.

Low self-esteem. Prior literature has illustrated that enlistment in the military may affect one's self-esteem and confidence (Rohall, Prokopenko, Ender, & Matthews, 2014). However, the extent to which self-esteem prior to selection into the military affects the likelihood of enlistment is relatively unknown. Thus, following prior literature (e.g., Swallen, Reither, Haas, & Meier, 2005) a measure of low self-esteem was constructed using six items that were asked at both waves 1 and 2 (12 total items; α = .89) where higher values indicated lower self-esteem.

Negative emotionality. Scholars have suggested that those with higher emotional stability may be more likely to enter military service (Miles & Haider-Markel, 2018). To assess this hypothesis a component of emotional stability, negative emotionality, was included in the analyses. In both waves 1 and 2, respondents answered 19 different questions tapping aspects of negative emotionality. These 38 items were employed to create an average

score for negative emotionality in adolescence (α = .91), where higher scores indicated higher levels of negative emotions.

IQ. A long line of research has indicated the broad influence of cognitive abilities and intelligence on selection into a variety of environmental niches, including military service (Strenze, 2007; Teachman, Call, & Segal, 1993). Consequently, a measure of IQ, derived from the Peabody Vocabulary Test (PVT), was included in the current study. The PVT is an abbreviated version of the Peabody Picture Vocabulary Test – Revised and is a standardized assessment of verbal skills and receptive vocabulary. The PVT was administered at Wave 1 and is a standardized continuous measure where higher scores indicated greater verbal competence.

Religiousness. Prior literature has illustrated the influence of religious attitudes on differential selection into a variety of types of employment (Gursoy, Altinay, & Kenebayeva, 2017). To assess the extent to which such selection into military service occurred, the current study included a measure of religiousness derived from four items asked at both waves 1 and 2 that have been used by prior scholars (e.g., Nedelec, Richardson, & Silver, 2017). The eight items were used to create an index that (α = .91) represents an average score of religiosity across adolescence, where higher values indicated greater religiousness.

Social support. Scholarship (e.g., Burrell, Durand, & Furtado, 2003; Johnson & Kaplan, 1991), personal anecdotes (e.g., Wright, 2008), and even popular culture depictions of military service indicate a perception of strong social support obtained from inclusion in the military. The extent to which levels of social support prior to military service affect the likelihood of selecting into the military, however, is relatively unknown (however, see Johnson & Kaplan, 1991). Consequently, a measure of social support derived from seven questions asked at both waves 1 and 2 (14 total items; α = .81; higher scores indicated greater social support across adolescence) was included in the analyses. Notably, this measure has been used by prior scholars employing the Add Health (e.g., Vaughn, Beaver, Wexler, DeLisi, & Roberts, 2011).

Delinquent peers. A vast criminological literature has illustrated the criminogenic effects of exposure to delinquent peers (e.g., Mazerolle & Maahs, 2000; Warr, 1993), including in genetically informed models (e.g., Nedelec et al., 2016). Additionally, scholars have noted that the composition of one's social network is likely to influence the probability of selecting into the military (Legree et al., 2000). To test the effect of delinquent peers on military enlistment three questions asked at both waves 1 and 2 were employed to form an average number of delinquent peers measure during adolescence (six total items; α = .84), where higher values indicated a greater average number of delinquent peers.

Violent delinquency. Some scholars and commentators have noted that selection into the military may be driven, in part, by one's desire and proclivity to engage in violent behavior (Bachman, Segal, Freedman-Doan, & O'Malley, 2000; Bouffard, 2005; Johnson & Kaplan, 1991; MacManus et al., 2015). To empirically account for this hypothesis a measure of violent behavior that has been employed by prior scholars (e.g., Nedelec et al., 2016) was included in the current study. Using six items that were asked at both waves 1 and 2, an average score tapping violent delinquency (12 total items; α = .85; higher scores indicate higher levels of violent behavior) was included in the analyses.

Grades in high school. While prior literature has employed measures of completed education in assessing the probability of military enlistment (e.g., Miles & Haider-Markel, 2018) we chose to use a measure of academic performance in high school given that most of the Add Health respondents had not yet completed their education by Wave 2. Eight items (four items from each of waves 1 and 2) were used to create an index measuring grades in high school (α = .85; higher scores indicated greater academic performance).

Personality variables during adulthood

While the individual differences in adolescence measures provide an opportunity for adherence to temporal ordering in predicting military enlistment only some of the measures assess components of personality. Unfortunately, the Add Health did not begin including items tapping the Big 5 components of personality until Wave 4. As a result, the personality measures included herein occur at the same wave as the military enlistment measure. Nonetheless, to assess any potential concurrent association between personality and military enlistment we include variables tapping each component of the five-factor model of personality as well as a composite measure tapping the higher-order general factor of personality (GFP). The five-factor model variables were *extraversion, neuroticism, agreeableness, conscientiousness*, and *openness*. These variables were all constructed by the Add Health research team using items derived from the Mini-International Personality Item Pool (IPIP-BF; Baldasaro,

Shanahan, & Bauer, 2013) where higher scores indicate greater levels of the indicated personality trait.

General factor of personality (GFP). A large swath of empirical literature has documented higher- and lower-order factors of personality (Kotov et al., 2017). In order to add to this growing body of literature, we also created an overall (i.e., higher-order) measure of personality using the constituent items of the five-factor model described above. Following prior studies in the personality literature (e.g., Dunkel, Nedelec, & van der Linden, 2018) we conducted a factor analysis of the five items using principal axis factoring. The first unrotated factor (Eigenvalue = 0.81) was extracted and employed as a measure of GFP, where higher scores indicated a greater degree of social effectiveness (van der Linden, Dunkel, & Petrides, 2016). The factor loadings were as follows: openness (.47), conscientiousness (.29), extraversion (.45), agreeableness (.48), and neuroticism (−.28).

Control variables

Demographic characteristics. Given the analytical strategy employed in the current study (see below), all multivariate models included controls for *Age* (measured in years and obtained by subtracting the year of the respondent's birth from the interview year), *Sex* (measured dichotomously such that 0 = female, and 1 = male), and *Race* (measured dichotomously such that 0 = NonWhite, and 1 = White).[2] Additionally, the analyses also controlled for region of residency during data collection with the inclusion of three dummy variables for *West, Midwest*, and *Northeast* (*South* served as the reference category). Finally, a dummy variable indicating that a twin was part of a different-sex DZ pair was also included in the multivariate models. All control variables were derived from Wave 1.

Analytical plan

The analysis for the current study was conducted using the n = 1,232 twins who were non-missing on the military enlistment question and followed four interrelated steps. First, descriptive statistics of the study variables were produced. Second, we examined the average differences on all study variables (i.e., individual differences in adolescence, personality characteristics in adulthood, and the control variables) between the two groups of twins who did and did not indicate military service. This step provided an initial indication regarding the potential for individual and personality differences to affect the decision to enlist in the military. Third, a series of traditional multivariate logit regression (baseline) models were estimated wherein military enlistment was regressed on the covariates of interest and the control variables. For the sake of brevity, the results of the baseline analyses are provided in the supplemental materials (see tables S1 to S4) rather than in the main text.

While the baseline multivariate logit models allow for an assessment of the effects of the covariates net of the influence of the control variables, other potential confounding variables could be affecting any observed associations. Given the accumulating evidence of genetic influence on military enlistment (Beaver et al., 2015; Miles & Haider-Markel, 2018), it is likely that unmeasured familial effects (both genetic and environmental in origin) could be biasing the association (Barnes, Boutwell, Beaver, Gibson, & Wright, 2014a). Consequently, the final step of the analysis employed a genetically informed approach in order to address this potential confounding. Referred to as the twin-comparison design, the approach has been illustrated to be effective in addressing the confounding influence of genetic and other shared familial factors (Barnes et al., 2014b; Lahey & D'Onofrio, 2010; Schwartz, 2017; Turkheimer & Harden, 2014). In brief, the twin-comparison design is akin to a fixed-effects regression model and includes estimates of both the *between-family* and *within-family* effects of covariates on an outcome of interest.[3] While the between-family effect is similar in interpretation to a coefficient estimated using a traditional regression technique, the within-family effect acts as the genetically informed component of the approach and assesses the extent to which variation within a twin-pair on the key covariate(s) affects variation within a twin-pair on the outcome. Note that this analytical technique assumes heritable influence on the outcome but does not provide a heritability estimate as is done in conventional phenotypic decomposition analyses. Shared genetic (in the aggregate sense) and other shared latent (non-genetic) familial factors (e.g., socioeconomic status) are accounted for within the model by the within-family component given that the twins within a twin-pair share those factors. Thus, the twin comparison method allows for the assessment of the effect of an independent variable of interest on an outcome net of the impact of the other covariates and any other unmeasured latent sources of influence that are shared between the twins within a twin pair (i.e., shared genetic and shared non-genetic factors; Wright et al., 2015). Note that this analytical technique assumes heritable influence on the outcome but does not provide a heritability estimate as is done in conventional phenotypic decomposition analyses.

Consequently, the final step of the analysis included the estimation of a series of logit regression models that included an average score on the independent variable of interest for each twin pair (between-family effect) and a twin deviation score for each individual twin (within-

family effect), along with the control variables. Given that twins are nested within families all regression models were clustered by family and employed robust standard errors.

Results

The analyses began with the production of descriptive statistics, which are displayed in Table 1. As illustrated, approximately 8% (n = 99) of the analytical sample indicated ever having served in the military. While this proportion of the sample is low, it aligns with the proportion of non-twins within the Add Health study who indicated military service (approximately 7%). Of the respondents indicating military service, approximately 30% were from twin-pairs who were discordant for military enlistment (i.e., one twin served in the military while the co-twin did not). In terms of the demographic composition of the analytical sample, the average age at Wave 1 was 16 years,[4] about 51% of the twins were male, and 62% of the twins were White. Most of the twins were living in the South (45%) at Wave 1, while 23% resided in the West, 22% resided in the Midwest, and 10% in the Northeast.

Also, included in Table 1 is an analysis of the average differences on the study variables between the group of twins in the analytical sample who indicated military service compared to those who did not indicate military service. As illustrated, there were average differences between the two groups in terms of social support ($t_{(111.84)}$ = 2.53, p = .013), and grades in high school ($t_{(110.35)}$ = 2.15, p = .034) such that those twins with no military service indicated higher average scores in adolescence on both variables. There were no significant differences in terms of the average scores on the personality measures between the military and nonmilitary service groups. Finally, there were more males, a lower proportion of respondents from the Midwest, and a higher proportion from the South in the military service group.

To more fully illustrate the average (non-)differences between the groups we also produced estimates of the means for the study variables and plotted them in Figure S1 (see supplemental materials). As illustrated, for almost all variables the 95% confidence intervals associated with the estimated means overlap between the two groups indicating a lack of statistical differences on the variables (the one exception being social support). A sufficient pattern of average differentiation, though

Table 1. Descriptive statistics of all study variables for the analytical sample, the military service subsample, and the nonmilitary subsample.

	Full Analytical Sample (n = 1,232)				Military Service (n = 99)				No Military Service (n = 1,133)				
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	t-value[†]
Dependent Variable (W4)													
Military service	0.08	0.28	0	1	–	–	–	–	–	–	–	–	–
Adolescent IVs (Ws 1 & 2)													
Low self-control	−0.01	0.34	−1.01	1.55	−0.02	0.35	−0.82	0.84	−0.01	0.34	−1.13	1.55	0.38
Low self-esteem	1.84	0.53	1	4.67	1.81	0.58	1	3.83	1.82	0.52	1	4.50	0.28
Negative emotionality	−0.02	0.48	−0.78	1.89	−0.02	0.49	−0.76	1.78	−0.01	0.48	−0.78	1.89	0.22
IQ	98.30	14.78	13	138	100.20	11.14	63	124	98.49	14.44	15	136	−1.39
Religiousness	0.04	0.79	−1.43	1.15	−0.03	0.78	−1.41	1.15	0.05	0.79	−1.43	1.15	0.97
Social support	4.06	0.53	1	5	3.92	0.59	2.42	5	4.07	0.51	1	5	2.53*
Delinquent peers	0.88	0.82	0	3	1.01	0.94	0	3	0.87	0.81	0	3	−1.42
Violent delinquency	−0.04	0.56	−0.33	4.95	0.04	0.64	−0.33	3.28	−0.04	0.57	−0.33	4.95	−1.14
Grades in high school	2.81	0.69	1	4	2.69	0.59	1	4	2.83	0.70	1	4	2.15*
Adult Personality IVs (W4)													
Openness	14.44	2.37	6	20	14.43	1.87	11	19	14.44	2.41	6	20	0.08
Conscientiousness	14.89	2.63	4	20	14.56	2.48	7	20	14.92	2.65	4	20	1.40
Extraversion	13.29	3.04	4	20	12.77	2.92	8	20	13.33	3.05	4	20	1.83
Agreeableness	15.20	2.39	4	20	14.76	2.41	7	20	15.24	2.38	4	20	1.91
Neuroticism	10.35	2.74	4	20	10.09	2.74	4	18	10.37	2.74	4	20	0.99
GFP	0.01	0.68	−2.36	2.36	−0.10	0.61	−1.69	1.94	0.02	0.68	−2.36	2.36	1.83
Control Variables (W1)													
Age	16.08	1.63	12	20	16.29	1.72	13	19	16.02	1.62	13	20	−1.50
Sex (1 = male)	0.51	0.50	0	1	0.72	0.45	0	1	0.47	0.50	0	1	−5.14*
Race (1 = White)	0.62	0.49	0	1	0.54	0.50	0	1	0.63	0.48	0	1	1.85
Region													
West	0.23	0.42	0	1	0.22	0.42	0	1	0.23	0.42	0	1	0.28
Midwest	0.22	0.41	0	1	0.12	0.33	0	1	0.23	0.42	0	1	2.83*
Northeast	0.10	0.30	0	1	0.06	0.23	0	1	0.10	0.30	0	1	1.80
South (reference)	0.45	0.50	0	1	0.60	0.49	0	1	0.44	0.50	0	1	−3.03*

Notes."IVs": independent variables; >"W>": Wave; full analytical sample includes MZ twins (n = 482; 241 pairs), same-sex DZ twins (n = 410; 205 pairs), and different-sex DZ twins (n = 340; 170 pairs); [†]Assessment of average difference on each variable between the non-military and military subsamples (Welch's *df* approximation employed); *p < .05, two-tailed test.

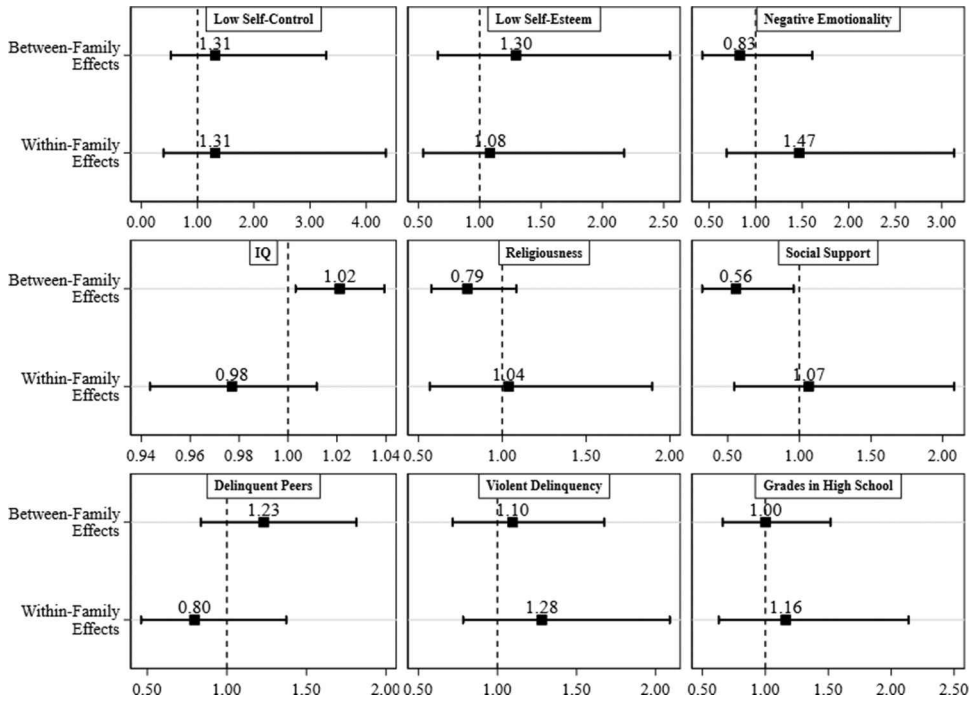

Figure 1. Results of logit regression models estimating the between- and within-family effects of individual differences during adolescence on military enlistment (odds ratio and 95%CI displayed). *Notes*: Each square within the figure represents a single logit regression model; each model controlled for region, age, sex, race, different-sex DZ twin pair, and was clustered by family id (robust standard errors were employed); Ns = 1,030 to 1,115; see Table S5 in the supplemental material for full model estimation.

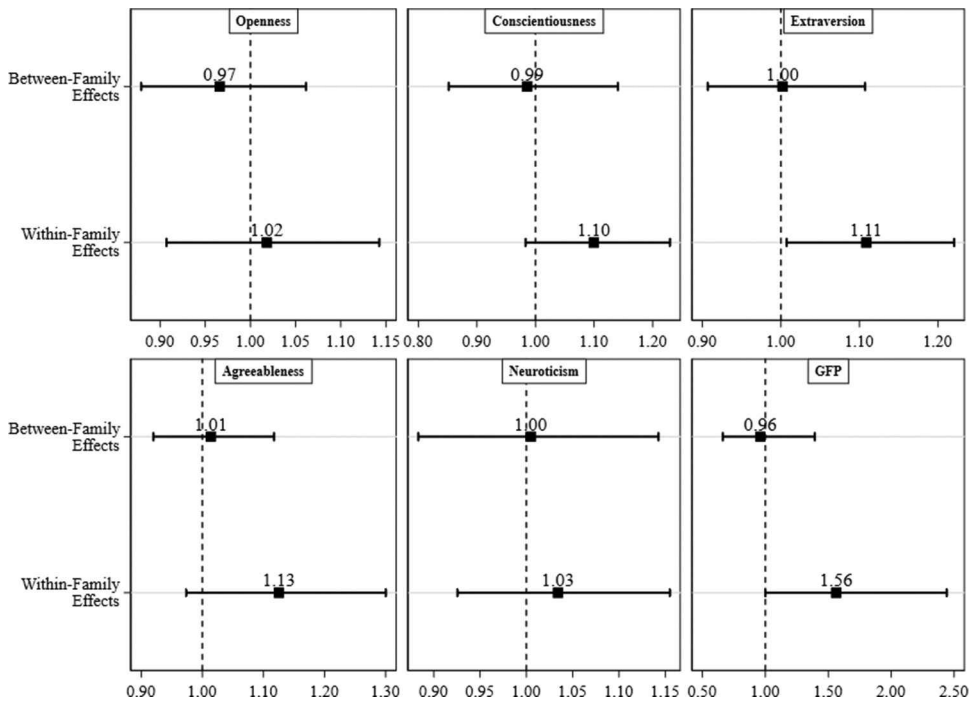

Figure 2. Results of logit regression models estimating the between- and within-family effects of personality characteristics (measured during adulthood) on military enlistment (odds ratio and 95%CI displayed). *Notes*: Each square within the figure represents a single logit regression model; each model controlled for region, age, sex, race, different-sex DZ twin pair, and was clustered by family id (robust standard errors were employed); Ns = 1,107 to 1,111; see Table S7 in the supplemental material for full model estimation.

not statistically significant, is seemingly apparent between the groups, however. Thus, to further examine the pattern of differentiation and avoid decision-making based solely on *p*-values alone (Cumming, 2012; Open Science Collaboration, 2015) we continued the analyses by estimating a series of regression models.

Baseline logit regression models were estimated to assess the association between the original independent variables and the likelihood of enlisting in the military (net of the control variables; see tables S1 and S4 in the supplemental materials for results). Overall, and not surprisingly, most of the coefficients for the independent variables of interest were not statistically significant. The two exceptions, however, were for IQ (b = .02, SE = .01, p = .005, OR = 1.02, OR95%CI = 1.01, 1.04) and social support (b = – .43, SE = .21, p = .043, OR = .65, OR95% CI = 0.43, 0.99). Yet, to the extent that unmeasured latent factors influence these associations, there could be residual confounding. Thus, the final step in the analyses was the estimation of a series of twin-comparison models. As a reminder, a statistically significant between-family effect is interpreted in a similar fashion to a conventional regression coefficient while a significant within-family effect is interpreted such that the twin with the higher score on the independent variable of interest is more (or less) likely to have enlisted in the military relative to their co-twin.

The results of the twin-comparison analyses are displayed in Figure 1 (individual differences during adolescence) and Figure 2 (personality characteristics during adulthood; see tables S5 and S7 in the supplemental materials for full model estimations). As illustrated in Figure 1, most of the odds ratios associated with the individual difference in adolescence variables (indicated in the title box within each portion of the figure) were null. In line with the baseline models, the between-family effect for both IQ (b = .02, SE = .01, p = .021, OR = 1.02, OR95%CI = 1.01, 1.04) and social support (b = – .58, SE = .28, p = .036, OR = .56, OR95%CI = 0.32, 0.96) were statistically significant but the within-family effects for these variables were not. Thus, these findings indicate that the association between these independent variables of interest and enlisting in the military are likely affected by latent factors shared by twins within a twin pair. Overall, it appears that individual differences during adolescence do not influence the likelihood of enlisting in the military once shared genetic and environmental (i.e., non-genetic) confounds are considered.

The results of the models assessing the association between personality characteristics in adulthood and military service are displayed in Figure 2 (see Table S7 in the supplemental materials for full estimation information). Overall, most of the personality characteristics exhibited null associations with the likelihood of enlisting in the military. However, a within-family effect of extraversion was observed such that the twin who scored higher (i.e., was more extraverted) was also more likely to enlist in the military relative to their co-twin (b = .10, SE = .05, p = .035, OR = 1.11, OR95%CI = 1.01, 1.22). Additionally, a within-family effect was observed for GFP such that the twin who scored higher on the measure of GFP was more likely to enlist in the military relative to their co-twin (b = .44, SE = .23, p = .050, OR = 1.56, OR95%CI = 1.00., 2.44).[5]

Discussion

In the current study, we analyzed data from the Add Health respondents to examine a range of individual level traits and their influence on decisions to enlist for military service. While prior work had already began building a body of knowledge related to this topic, almost no research to date has employed designs capable of making reasonably strong causal inferences (though see Miles & Haider-Markel, 2018). Our analysis of twin pairs drawn from the Add Health offer that ability by simultaneously controlling for shared genetic and shared non-genetic confounds and allowing putative effects of certain independent variables to be investigated (Turkheimer & Harden, 2014). Our results revealed at least two key findings.

First, and arguably most notably, virtually no individual-level predictors emerged for military enlistment. Null findings are relevant, if for no other reason than to exclude or avoid them contributes to the already extant problems described surrounding replicability in the psychological sciences (Open Science Collaboration, 2015). More specifically, what this suggests is that for various personality and individual level factors that might correlate with military service, the associations seem primarily due to shared familial factors (both genetic and non-genetic) that cut across both the propensity to join the armed forces, as well as the personality traits in question. Second, two individual level traits did emerge as predictors of military service, even in the more restrictive twin-based models. Twins scoring higher on measures of extraversion and the GFP measure were more likely to enlist for service (compared to lower scoring co-twins). The results regarding extraversion, in particular, are interesting, given that they appear to conflict with Miles and Haider-Markel (2018) who reported no association between military service and extraversion in their prior analysis. Our results also suggested that greater social functioning overall – as putatively assessed by the GFP – predicted military service, beyond familial confounding.

Assuming they replicate in future studies, these results illustrate something about the personality profile of volunteers for military service. Beyond family level effects, individuals who are socially adept and generally outgoing should be more likely to seek out the experiences provided by military service, including travel, acquisition of novel skills, exposure to diverse cultures, and the ability to function successfully in a highly routinized and structured environment. Unlike Miles and Haider-Markel (2018), however, we found little evidence to suggest any type of causal influence stemming from variation across other big five domains or other potential individual-level traits measured in the sample.

With these results in mind, it is important to consider the limitations of our analysis. First, while the quantitative genetic models in the current study offer a powerful (quasi-experimental) approach to causal inference (see Lee, 2012), confounding factors that are unique to each member of the twin pair (e.g., nonshared environmental confounders) could still render any association observed spurious (D'Onofrio, Lahey, Turkheimer, & Lichtenstein, 2013). As a result, caution remains appropriate when suggesting that either the GFP or extraversion exert causal effects on military service. Second, while there is some disagreement in the personality literature regarding the validity of the GFP as a measure of overall social functioning (van der Linden et al., 2016), it is worth noting that our analyses were not centered on this construct and the GFP was included as one potential source, among many, of variation in enlistment. Indeed, the analyses capitalized on a large number of available measures of individual differences. Additionally, to exclude the GFP would hinder future efforts to meta-analyze the literature assessing the construct. Thus, while we created and employed the item in our analyses we are cautious to make any claim that it is a singular trait that is key to life or occupational success. Third, as noted in the Methods section, questions addressing both the Big 5 personality components and military enlistment were asked during the Wave 4 interview. Although the majority of the respondents were in their late-20s and early-30s during Wave 4 – suggesting that personality traits are likely (relatively) stable at that point (see Briley & Tucker-Drob, 2014 for a review) – a causal association cannot be concluded given our inability to properly guarantee the preservation of temporal order. It's worth noting, however, that the remainder of the individual-level traits (i.e., adolescent IVs) were measured well before the outcome variable and therefore adhere to proper temporal order. Finally, questions have arisen in the past about the generalizability of results gleaned from twin-based samples, yet analysis of the Add Health data has suggested that little difference generally exists between twins and non-twins across a wide swath of key individual level traits (Barnes & Boutwell, 2013). To assess this potential limitation, post-hoc sensitivity analyses were conducted wherein we examined the average differences on all study variables between the analytical sample and the rest of the Add Health sample. The results of these analyses are presented in the supplemental materials (Table S9). As illustrated, while some average differences were evident none of the differences were substantial in terms of effect size (Cohen's $d < .15$ for all comparisons).

Ultimately, individual level research capable of disentangling genetic from environmental effects as it relates to military service is severely limited (Beaver et al., 2015; Miles & Haider-Markel, 2018). While much more is known about the *correlates* of military enlistment, it remains unclear whether these correlates represent *causal* influences once appropriate statistical techniques are employed. Our results provide some tentative evidence that social functioning (broadly defined and measured) and the trait of extraversion may play some role in voluntary military service. However, larger samples of twins and data which adhere to temporal ordering will be necessary in determining whether the results gleaned here replicate. Nonetheless, our findings, coupled with those of Miles and Haider-Markel (2018), provide a wider platform from which future scholars can continue to probe interesting questions about both military enlistment, as well as various outcomes that are of interest while individuals are actively serving in the military.

Notes

1. All participants in the Add Health study provided written informed consent for participation in all aspects of the study (https://www.cpc.unc.edu/projects/addhealth/faqs/addhealth/index.html#Was-informed-consent-required). Given that the data employed in the current study are secondary and de-identified, the Institutional Review Board at the University of Cincinnati determined that the data did not meet the regulatory criteria for research involving human subjects.
2. Models were reassessed using multiple racial category variables (i.e., White [reference], Black, American Indian, Asian, Other, and Hispanic ethnicity) as covariates and the results were virtually identical to those reported herein and no differences in terms of the likelihood of enlistment were observed across the different racial categories. Thus, for the sake of parsimony the dichotomous measure of race is employed in the current study.
3. The between-family and within-family variables were created for each covariate following a two-step procedure. First, an overall family mean for each independent variable was created by averaging the scores for two

twins from the same family on the corresponding independent variable. Second, a mean deviation score for each twin within a twin pair was created by subtracting a twin's score on an independent variable from the family mean for the same variable.

4. For reference, the mean age at Wave 4 was 29.05 years (SD = 1.64, Min., Max. = 25, 33).
5. We note that the *p*-value associated with this coefficient is precisely.05 so it is considered statistically non-significant. Nonetheless, given the stringent nature of the modeling strategy and the breadth of the associated 95%CI we highlight this effect herein.

Disclosure statement

No potential conflict of interest was reported by the authors.

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