Eysenck Personality Questionnaire – Revised Short Form Neuroticism Factors and Five-Factor Model Domains and Facets

Alexander Weiss
The University of Edinburgh

Variance in the Eysenck Personality Questionnaire Revised Short Form's (EPQ-RS) Neuroticism scale is divisible into a general factor (Neuroticism) and two special factors (Anxious-Tense and Worried-Vulnerable), and although all three factors are associated with poorer mental health, their associations with physical health differ: the general Neuroticism factor was associated with poorer health, the association between the Anxious-Tense factor and health was mixed, and the Worried-Vulnerable factor was associated with better health. One unanswered question is how these factors map onto the domains of the Five-Factor Model of personality, and these domains' lower-order facets? I addressed this question by collecting data from 230 first year psychology undergraduates. These participants completed the 12-item EPQ-RS Neuroticism scale and the 30-item short form version of the Big Five Inventory-2 (BFI-2-S). The general Neuroticism factor was associated positively with higher Neuroticism and its facets of Anxiety, Depression, and Emotional volatility. This factor was also associated negatively with Extraversion and its facet Energy level, Agreeableness and its facet Trust, and with Conscientiousness. The Anxious-Tense factor was associated positively with Neuroticism and its facet Anxiety, and negatively with Extraversion and its facet Assertiveness. The Worried-Vulnerable factor was associated positively only with Neuroticism and its facet Anxiety. Future epidemiological studies should be cautious when interpreting the effects of Neuroticism when it is measured using the EPQ-RS and should seek to replicate the present findings in larger, representative samples, and with comprehensive measures of the Five-Factor Model, such as the NEO Inventories.

Neuroticism is one of the five broad domains—or factors—of human personality, and describes stable differences in the degree to which individuals are, for example, emotionally unstable, impulsive, and prone to experiencing negative affect (Digman, 1990). High Neuroticism is related to an increased tendency to engage in health risk behaviors, including tobacco use and excessive alcohol consumption, and it has thus been deemed a target for public health interventions (Lahey, 2009). That said, several researchers have recognized that Neuroticism's associations with physical health outcomes are heterogeneous, and have stressed that further research is necessary if we wish to improve our understanding of how Neuroticism impacts health (Lahey, 2009; Roberts et al., 2007).

To try and understand why some studies found an inverse association between Neuroticism and poor health, Čukić reviewed the literature on the relationship between Neuroticism and all-cause mortality (Čukić, 2015). She noted in her review that Neuroticism was related to lower mortality in studies that included self-rated health as a covariate (e.g., Korten et al., 1999) and higher mortality in studies that did not do so (e.g., Wilson et al., 2005). The findings from a mega-analysis (Beck &

Jackson, 2022) and a cohort study (Gale et al., 2017) supported Čukić's observations concerning the effect of controlling for self-rated health on the association between Neuroticism and mortality. In an attempt to understand *why* including self-rated health caused the direction of the Neuroticism-mortality relationship to reverse, the investigators of the cohort study (Gale and her colleagues) conducted a series of exploratory analyses. In one of these analyses, they tested whether lower-level traits (facets) of Neuroticism had different associations with mortality. To do so they first used an exploratory bi-factor analysis (Jennrich & Bentler, 2011, 2012) to test whether the Neuroticism items from the short-scale Eysenck Personality Questionnaire Revised (EPQ-RS; Eysenck et al., 1985) defined special factors alongside a general Neuroticism factor. The authors found that, in addition to the general Neuroticism factor, there were two special factors. One special factor loaded on items associated with feeling tense and/or anxious, such as "Would you call yourself a nervous person?". The other loaded on items associated with feeling worried and/or vulnerable, such as "Do you worry too long after an embarrassing experience?". In further analyses, these authors showed that the Anxious-Tense factor was not associated with all-cause mortality and that the Worried-Vulnerable factor was associated with reduced risk.

Subsequent studies supported the findings from this cohort study. For instance, one study (Weiss et al., 2019) replicated the factor structure of the EPQ-RS Neuroticism items in two independent samples and showed in the original sample investigated by Gale et al. (2017) that, even in models that did not include self-rated health, the general factor was associated with greater mortality, the Worried-Vulnerable factor was associated with reduced mortality, and the Anxious-Tense factor was not associated with mortality. A later study (Weston & Jackson, 2018) found that the effect of Neuroticism mediated by 'body vigilance' (the indirect effect) was related to better health outcomes whereas the direct effect of Neuroticism was related to poorer health outcomes. Finally, genetic correlations between these Neuroticism factors and outcomes yielded results consistent with the original cohort study (Hill et al., 2019; Nagel et al., 2018).

The factors derived from the EPQ-RS Neuroticism scale thus appear to measure constructs that differ phenotypically, genetically, and in whether and how they influence physical health. What is not yet understood is what the relationship of these factors is to Neuroticism and the other broad domains of the Five-Factor Model, and the lower-order facets that make up these domains. To address this question, I collected data on the EPQ-RS Neuroticism scale and the 30-item Big Five Inventory-2-Short (BFI-2-S; Soto & John, 2017a, 2017b) in undergraduate students, and examined the associations between the constructs that these scales measure.

Method

Participants

From March 12, 2021, to March 19, 2021, as part of a class exercise, 295 first year undergraduate psychology students at the University of Edinburgh participated in a study on personality and COVID-19. Excluded participants included 13 who did not complete all 30 BFI-2-S items or all 12 EPQ-RS items. After additional screening, a further 52 participants were excluded: 14 who completed the survey in less than 2.38 minutes (the 5th percentile), 10 who responded "Neutral/No opinion" to more than 10 (the 95th percentile) BFI-2-S items, seven who responded "Disagree strongly" or "Disagree" to more than 15 BFI-2-S items (the 95th percentile), eight who responded "Agree strongly" or "Agree" to more than 20 items (the 95th percentile), two who reported being 17 years old, 11 who did not report their age, and one who reported their gender identity as "The Magic Rainbow Unicorn of Magic".

The 230 participants that remained ranged in age from 18 to 42 years (M = 19.49, SD = 3.38) and included 192 individuals who reported their natal sex as female, 37 who reported their natal sex as male, and 1 who did not report their natal sex. Of the participants who reported their natal sex as female, 186 identified as female, three identified as non-binary, one identified as gender fluid, and two declined to answer the question. All participants who reported their natal sex as male identified their gender as male. The sample was ethnically diverse: 159 participants identified as White British, White Irish, or White other, 48 identified as Chinese, 10 identified as Indian, Pakistani, or "Other Asian", one identified as Black or Black British, nine identified as "Mixed or Multiple", two reported belonging to some "Other Ethnic Group", and one participant declined to report their ethnicity.

Measures

Short-Scale Eysenck Personality Questionnaire-Revised Neuroticism

The EPQ-RS Neuroticism scale consists of 12 items sampled from the 24-item Neuroticism scale of the Eysenck Personality Questionnaire-Revised (Eysenck et al., 1985). The EPQ-RS's instructions tell participants to answer "Yes" or "No" to each items and to "[w]ork quickly and do not think too long about the exact meaning of the questions." (Eysenck et al., 1985) The EPQ-RS Neuroticism scale's internal consistency reliability (Cronbach's alpha) is high (Eysenck et al., 1985), as is its test-retest reliability (e.g., Alexopoulos & Kalaitzidis, 2004), and its convergent and discriminant validity (e.g., Gow et al., 2005).

Big Five Inventory-2-Short

I intended to administer participants the BFI-2 (Soto & John, 2017a). However, due to an error on my part, participants were administered the BFI-2-S (Soto & John, 2017b), a 30-item version of the 60-item BFI-2.

The BFI-2-S, like the BFI-2, operationalizes the five major domains of personality—Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness—and three facets for each domain. Each BFI-2-S item consists of a brief statement (e.g., "Tends to be Quiet") to which participants can respond on a five-point scale: 1 (*Disagree strongly*) to 5 (*Agree strongly*). The BFI-2-S measures each facet using two items and each domain by six items. The BFI-2 domain and facet scales display good evidence of their internal consistency reliability, interrater reliability, and retest reliability. There is also evidence for the convergent and discriminant validity of these scales (Soto & John, 2017a). The BFI-2-S's reliability and validity are also good, but they are approximately 10% lower than those of the BFI-2 (Soto & John, 2017b, p. 78).

Analyses

Transparency and Openness

I used version 4.2.1 of R (R Core Team, 2022) to conduct the analyses and both the umx_APA_pval() function from the umx library (Bates et al., 2019) and kbl() function from version 1.3.4 of the kableExtra library (Zhu, 2021) to create one of the tables. Data and code are available at the Open Science Framework (Weiss, 2024).

Data Preparation

Following the BFI-2-S scoring instructions (Soto & John, 2017b), I computed unit-weighted factor scores (Gorsuch, 1983) to represent the BFI-2-S domain and facet scales. I then used the factor.scores() function from version 2.2.9 of the psych package (Revelle, 2023) to create standardized scores for the general Neuroticism factor, and both the Anxious-Tense and Worried-Vulnerable special factors. The factor score coefficients matrix used to create these scores preserved the correlations between the three factors (Grice, 2001; ten Berge et al., 1999) and was based on the 12 x 3 factor loading matrix and the 3 x 3 factor intercorrelation matrix from Gale et al.'s bi-factor analysis (Gale et al., 2017, p. 1351). I included both matrices in the online data and code.

Bivariate Correlations

I used the corr.test() function from the psych package to calculate correlations between unit-weighted factor scores representing the BFI-

2-S domains and facets and the EPQ-RS factors. As there were 60 correlations, I used the Holm-Bonferroni correction (Holm, 1979) to control for the family-wise error rate.

Joint Factor Analysis

To examine the relationships between the BFI-2-S and EPQ-RS factors, I used the fa() function from the psych package to conduct a joint factor analysis of the 15 BFI-2-S facet scales, and the EPQ-RS factors. For this analysis, I extracted five factors using the method of minimum residuals (Harman & Jones, 1966) and subjected these factors to an oblique (oblimin) rotation.

Simultaneous Multiple Regressions

Because each unit-weighted BFI-2-S scale is a mixture of general factor variance (from the domain that it belongs to) and unique variance, to test for the relationships between the unique variance from each of the 15 BFI-2-S facets and from the three EPQ-RS factors, I conducted simultaneous multiple regressions using the lm() function. In these analyses I regressed one EPQ-RS factor onto one domain's facets. To obtain standardized regression coefficients (βs), I standardized the facet scores before conducting these analyses.

Ethics

The University of Edinburgh School of Philosophy, Psychology and Language Sciences Ethics Committee granted ethical approval for this study on March 4, 2021 (#217-2021/4). The study took place online. Participation was anonymous and posed no potential risks or harm. Participants were not compensated for taking part in the study. Before starting, instructions informed participants about the study's purpose (to examine the relationship between personality traits and the risk or perceived risk of COVID-19 exposure). These instructions also informed participants that they could skip any question or questions that they wished to, and that they had the right to withdraw their consent at any time. Participants provided their electronic informed consent by clicking a link to the study.

Results

Bivariate Correlations

Table 1 shows the correlations between the EPQ-RS factors and the BFI-2-S domains and facets. The correlation between the general Neuroticism factor and the Neuroticism domain was large, positive, and statistically significant; correlations between the general Neuroticism factor and the Extraversion, Agreeableness, and Conscientiousness

domains were negative, small, and statistically significant. The correlation between the general Neuroticism factor and the Openness domain was not significant. The general Neuroticism factor also had moderate and statistically significant positive correlations with all three Neuroticism facets—Anxiety, Depression, and Emotional volatility—and small but statistically significant negative correlations with Energy level, a facet of Extraversion, and Trust, a facet of Agreeableness.

The correlation between the Anxious-Tense factor and the Neuroticism domain was positive and significant, but small. This factor also had a significant negative correlation of approximately the same magnitude with the Extraversion domain. The Anxious-Tense factor had a significant, moderate sized positive correlation with Anxiety, a facet of Neuroticism, and a significant, small sized, negative correlation with Assertiveness, a facet of Extraversion. The Worried-Vulnerable factor had small but statistically significant positive correlations with the Neuroticism domain and its facet, Anxiety.

Joint Factor Analysis

Table 2 shows the joint factor analysis results. The communalities, which indicate the amount of variance in the BFI-2-S facets and EPQ-RS factors accounted for by the five factors, had a wide range, and there was a ratio of 18 variables to three factors. The sample size for the factor analysis was therefore adequate (see Figure 1 in MacCallum et al., 1999). The five factors accounted for approximately 40% of the variance. The BFI-2-S facets that belonged to the same domain had their largest loadings on the same factor. Of the EPQ-RS factors, the general factor had a strong positive loading on Neuroticism and both Anxious-Tense and Worried-Vulnerable had their largest loadings (-.34 and -.25, respectively) on Extraversion.

Simultaneous Multiple Regressions

The associations between the unique variance associated with the BFI-2-S facets and the EPQ-RS factors were largely consistent with the results of the correlation analyses (see Table 3). The Neuroticism facets accounted for a significant portion of variance in the general Neuroticism factor, $R^2 = .579$, $F(3,226) = 103.500$, $p < .001$. The associations between all three Neuroticism facets and the general

Table 1
Correlations between Eysenck Personality Questionnaire Revised Short Form Neuroticism Phenotypes and Big Five Inventory Short Domains and Facets

Domain/facet	General Neuroticism		Anxious-Tense		Worried-Vulnerable	
	r	*95% CI*	*r*	*95% CI*	*r*	*95% CI*
Neuroticism	**.75*****	**(.64, .83)**	**.28*****	**(.07, .47)**	**.26****	**(.05, .45)**
N1: Anxiety	**.59*****	**(.43, .72)**	**.40*****	**(.20, .57)**	**.32*****	**(.11, .50)**
N2: Depression	**.69*****	**(.56, .79)**	.16	(-.05, .36)	.17	(-.04, .37)
N3: Emotional volatility	**.67*****	**(.53, .78)**	.17	(-.04, .37)	.19	(-.02, .38)
Extraversion	**-.28****	**(-.47, -.07)**	**-.23***	**(-.43, -.02)**	-.19	(-.39, .02)
E1: Sociability	-.16	(-.36, .05)	-.21	(-.40, .01)	-.15	(-.34, .06)
E2: Assertiveness	-.20	(-.40, .01)	**-.22***	**(-.42, -.01)**	-.19	(-.38, .03)
E3: Energy level	**-.31*****	**(-.49, -.10)**	-.14	(-.33, .07)	-.12	(-.32, .08)
Openness	.03	(-.16, .22)	-.11	(-.31, .09)	-.01	(-.17, .15)
O1: Aesthetic sensitivity	.08	(-.12, .28)	-.05	(-.24, .15)	-.03	(-.21, .16)
O2: Intellectual curiosity	.01	(-.15, .17)	-.12	(-.32, .08)	.04	(-.15, .23)
O3: Creative imagination	-.02	(-.20, .16)	-.11	(-.30, .10)	-.03	(-.21, .15)
Agreeableness	**-.24***	**(-.43, -.03)**	-.08	(-.28, .12)	.03	(-.16, .22)
A1: Compassion	-.12	(-.32, .09)	-.14	(-.33, .07)	.03	(-.15, .20)
A2: Respectfulness	-.18	(-.38, .03)	.02	(-.16, .19)	.03	(-.16, .22)
A3: Trust	**-.26****	**(-.45, -.05)**	-.06	(-.26, .14)	.02	(-.15, .19)
Conscientiousness	**-.24***	**(-.43, -.02)**	-.01	(-.16, .14)	-.06	(-.25, .14)
C1: Organization	-.17	(-.37, .04)	-.01	(-.14, .12)	-.06	(-.25, .14)
C2: Productiveness	-.21	(-.41, .00)	.04	(-.16, .23)	-.03	(-.22, .16)
C3: Responsibility	-.19	(-.39, .02)	-.06	(-.25, .14)	-.04	(-.24, .15)

Note. *p < .05; **p < .01; ***p < .001. *95% CI* = 95% confidence interval, respectively. 95% confidence intervals and *p*-values adjusted using the Holm-Bonferroni method. Significant correlations in boldface.

Neuroticism factor were positive and statistically significant. The Extraversion facets also accounted for a significant portion of variance in the general Neuroticism factor, R^2 =.105, $F(3,226)$ = 8.839, $p < .001$. The association between Energy level and the general Neuroticism factor was negative and statistically significant. The Openness facets did not account for a significant portion of variance in the general Neuroticism factor, R^2 = .011, $F(3,226)$ = 0.861, p = .462, and none of the associations between the Openness facets and the general Neuroticism factor were significant. The Agreeableness facets accounted for a significant portion of variance in the general Neuroticism factor, R^2 = .080, $F(3,226)$ = 6.546, $p < .001$. The association between Trust and the general Neuroticism factor was negative and significant. The Conscientiousness facets accounted for a significant portion of variance in the general Neuroticism factor, R^2 = .059, $F(3,226)$ = 6.546, p =.003. The associations between the Conscientiousness facets and the general Neuroticism factor were not statistically significant.

The Neuroticism facets accounted for a significant portion of variance in the Anxious-Tense factor, R^2 = .178, $F(3,226)$ = 16.260, p <.001. The association between Anxiety and the Anxious-Tense factor was positive and statistically significant. The Extraversion facets accounted for a statistically significant portion of variance in the Anxious-Tense factor, R^2 = .064, $F(3,226)$ = 5.147, p = .002. The association between Assertiveness and the Anxious-Tense factor was negative and statistically significant. Neither the Openness, R^2 = .018, $F(3,226)$ = 1.420, p = .238, Agreeableness, R^2 = .029, $F(3,226)$ = 2.284, p = .080, nor the Conscientiousness facets, R^2 = .008, $F(3,226)$ = 0.598, p = .617, accounted for a significant proportion of variance in the Anxious-Tense factor. The associations between the individual Openness, Agreeableness, or Conscientiousness facets and the Anxious-Tense factor were not statistically significant.

The Neuroticism facets accounted for a significant portion of the variance in the Worried-Vulnerable factor, R^2 = .104, $F(3,226)$ = 8.774, $p < .001$. The association between Anxiety and the Worried-Vulnerable factor was positive and statistically significant. The Extraversion facets accounted for a significant portion of the variance in the Worried-Vulnerable factor, R^2 = .040, $F(3,226)$ = 3.168, p = .025. The associations between the Extraversion facets and the Worried-Vulnerable factor were not statistically significant. Neither the Openness, R^2 = .005, $F(3,226)$ = 0.393, p = .758, Agreeableness, R^2 = .001, $F(3,226)$ = 0.097, p = .962, nor the Conscientiousness facets, R^2 = .004, $F(3,226)$ = 0.268, p = .835, accounted for a significant portion of variance in the Worried-Vulnerable factor.

Table 2
*Standardized Loadings (Pattern Matrix) Based Upon Correlation
Matrix of the Two EPQ-RS Group Factors and BFI-2-S Facet Scales*

	Neu	Ext	Con	Agr	Opn	h^2	com
EPQ-RS							
General factor	**.79**	.11	-.08	-.10	.09	.66	1.1
Anxious-Tense	.19	-.34	.20	.06	-.16	.21	2.9
Worried-Vulnerable	.19	-.25	.08	.16	-.07	.13	3.1
BFI-2-S							
N1: Anxiety	**.79**	-.15	.07	.09	-.08	.69	1.1
N2: Depression	**.75**	-.13	-.11	-.02	.06	.71	1.1
N3: Emotional volatility	**.83**	.10	.03	-.02	-.05	.65	1.0
E1: Sociability	.02	**.79**	-.05	.11	-.04	.62	1.1
E2: Assertiveness	-.08	**.51**	.20	-.18	.15	.41	1.8
E3: Energy level	-.11	**.54**	.24	.10	-.04	.52	1.6
O1: Aesthetic sensitivity	.07	-.10	-.05	.08	**.60**	.38	1.1
O2: Intellectual curiosity	.04	.08	.12	-.01	**.50**	.29	1.2
O3: Creative imagination	-.02	-.01	.02	.02	**.79**	.64	1.0
A1: Compassion	.05	.10	.00	**.77**	.08	.64	1.1
A2: Respectfulness	-.04	-.09	.15	**.60**	-.04	.42	1.2
A3: Trust	-.19	.05	-.13	**.57**	.05	.40	1.4
C1: Organization	.01	.09	**.73**	-.03	-.03	.55	1.0
C2: Productiveness	-.08	-.07	**.73**	.01	.05	.56	1.1
C3: Responsibility	.00	.11	**.44**	.30	.13	.46	2.1
Proportion of variance	.15	.09	.09	.09	.08		

Factor correlations					
	Neu	Ext	Con	Agr	Opn
Neu	1				
Ext	-.31	1			
Con	-.26	.26	1		
Agr	-.19	.15	.27	1	
Opn	-.04	.17	.09	.23	1

Note. EPQ-RS = Short scale Eysenck Personality Questionnaire Revised.
BFI-2-S = Big Five Inventory 2 Short Form. Neu = Neuroticism, Ext =
Extraversion, Con = Conscientiousness, Agr = Agreeableness, Opn =
Openness, h^2 = communalities, com = complexity. Loadings ≥ |.4| in
boldface.

Table 3
Simultaneous Multiple Regressions of the EPQ-RS General Factor and the EPQ-RS Group Factors onto the BFI-2-S Facet Scales

Facet	General Neuroticism			Anxious-Tense			Worried-Vulnerable		
	β	*95% CI*	*p*	β	*95% CI*	*p*	β	*95% CI*	*p*
N1: Anxiety	**.12**	**(.00, .24)**	**.044**	**.53**	**(.36, .69)**	**< .001**	**.35**	**(.18, .53)**	**< .001**
N2: Depression	**.39**	**(.27, .51)**	**< .001**	-.12	(-.29, .04)	.144	-.05	(-.23, .12)	.566
N3: Emotional volatility	**.35**	**(.23, .47)**	**< .001**	-.08	(-.24, .09)	.341	.00	(-.17, .17)	.991
E1: Sociability	.06	(-.10, .22)	.463	-.13	(-.29, .03)	.113	-.06	(-.23, .10)	.453
E2: Assertiveness	-.11	(-.26, .03)	.113	**-.17**	**(-.31, -.02)**	**.025**	-.14	(-.29, .00)	.053
E3: Energy Level	**-.30**	**(-.45, -.14)**	**< .001**	.00	(-.15, .16)	.971	-.03	(-.19, .13)	.686
O1: Aesthetic sensitivity	.12	(-.03, .27)	.126	.01	(-.14, .16)	.865	-.02	(-.17, .13)	.752
O2: Intellectual Curiosity	.02	(-.13, .17)	.804	-.10	(-.24, .05)	.193	.07	(-.08, .22)	.337
O3: Creative imagination	-.09	(-.25, .08)	.295	-.07	(-.23, .09)	.414	-.05	(-.21, .11)	.545
A1: Compassion	.06	(-.10, .21)	.476	-.19	(-.35, -.03)	.019	.01	(-.15, .17)	.891
A2: Respectfulness	-.12	(-.27, .02)	.101	.12	(-.03, .27)	.119	.03	(-.13, .18)	.722
A3: Trust	**-.25**	**(-.39, -.10)**	**< .001**	-.01	(-.16, .13)	.849	.00	(-.15, .15)	.982
C1: Organization	-.05	(-.21, .11)	.554	-.02	(-.18, .14)	.816	-.05	(-.21, .11)	.546
C2: Productiveness	-.14	(-.30, .02)	.088	.08	(-.08, .25)	.315	.01	(-.16, .17)	.942
C3: Responsibility	-.11	(-.26, .03)	.131	-.08	(-.23, .07)	.275	-.03	(-.17, .12)	.742

Note. 95% CI = 95% confidence interval. Constants omitted. Statistically significant effects in boldface.

Discussion

The EPQ-RS general Neuroticism factor was positively related to the BFI-2-S Neuroticism domain and negatively related to the BFI-2-S Extraversion, Agreeableness, and Conscientiousness domains. The general Neuroticism factor also had positive relationships with all three Neuroticism facets and negative relationships with the Energy level facet of Extraversion and Trust facet of Agreeableness. The EPQ-RS Anxious-Tense factor had a positive relationship with Neuroticism and its facet Anxiousness, and a negative relationship with Assertiveness, a facet of Extraversion. The EPQ-RS Worried-Vulnerable factor only had positive relationships with Neuroticism and its facet, Anxiousness. The results of a joint factor analysis, which examined where the EPQ-RS factors would load on the Five-Factor Model, and regressions that examined relationships between these factors and the variance specific to the BFI-2-S facets, were like those of the bivariate correlations.

One notable finding was that the general Neuroticism factor was associated with features of depression, including low energy, distrust, and avolition (Lyon et al., 2021) whereas the other factors were considerably narrower. Although these findings help clarify the nature of EPQ-RS Neuroticism, they do little to answer the question of what mechanisms are responsible for previous findings showing that people higher in the general Neuroticism factor experience poorer health, people higher in the Worried-Vulnerable factor experience better health, and that people higher in the Anxious-Tense factor do not uniformly experience better or poorer health (Gale et al., 2017; Weiss et al., 2019).

The present study is not without limitations. First, the BFI-2-S assesses, at most, half of the Five-Factor Model's facets (Costa & McCrae, 1995), and each facet is measured with just two items (see Chapman & Elliot, 2019 for discussions of known problems with brief measures of personality constructs; Weiss & Costa, 2014). Second, the authors of the BFI-2-S recommend that its facet scales should only be used in studies with at least 400 participants (p. 79 in Soto & John, 2017b), and the present study's sample size falls well short of that. Third, the study used a cross-sectional design and self-report data. Some associations may therefore be attributable to shared method variance. Finally, participants were first year undergraduates, most of whom were young women. However, this limitation is unlikely to have a large impact as the psychometric properties of the BFI-2-S do not differ appreciably between samples of university students and more representative samples (Soto & John, 2017b), and there is little reason to expect that the associations between different scales would be different in a more representative sample. Moreover, unusual for convenience samples, many participants (approximately one-third) were from diverse backgrounds.

Addressing these limitations may help understand why these Neuroticism factors have different effects on physical health. Examining correlations between the 30 facets of the NEO-PI-R (Costa & McCrae,

1992) or NEO-PI-3 (McCrae & Costa, 2010), and the EPQ-RS Neuroticism factors in more representative samples may further clarify what psychological constructs are assessed by the EPQ-RS Neuroticism scale. In addition, investigating the genetic correlations between the Five-Factor Model facets and the EPQ-RS Neuroticism factors could be used to test whether genetically and environmentally mediated correlations are opposite in sign, and so 'hide' correlations between phenotypes. To test these possibilities requires studying associations between the EPQ-RS factors and the Five-Factor Model's facets in genetically informative samples, such as of mono- and dizygotic twins, or by using molecular data.

The present findings offer recommendations for future studies of Neuroticism and health. Briefly, future studies would benefit by using Neuroticism scales with good discriminant validity or, absent that, assess the relationship between Neuroticism and health controlling for Agreeableness, Conscientiousness, Extraversion, and (possibly) depression. Meta-analyses that test whether the heterogeneity in the association between Neuroticism and health (Jokela et al., 2013) is attributable to how much the Neuroticism measures used in a study overlap with other constructs will also be worthwhile in this regard.

Conclusion

The present study provided insight into the EPQ-RS's Neuroticism scale, which is often used in studies of health. The three factors identified using bi-factor analysis differ in terms of their patterns of associations with the Five-Factor Model domains and some of its facets. There is thus a need to further assess Neuroticism and its effects at multiple levels of granularity. Until that time, researchers should take care when interpreting associations between Neuroticism and physical health or other outcomes.

References

Alexopoulos, D. S., & Kalaitzidis, I. (2004). Psychometric properties of Eysenck Personality Questionnaire-Revised (EPQ-R) Short Scale in Greece. *Personality and Individual Differences*, *37*(6), 1205-1220. https://doi.org/https://doi.org/10.1016/j.paid.2003.12.005

Bates, T. C., Neale, M. C., & Maes, H. (2019). umx: A library for Structural Equation and Twin Modelling in R. *Twin Research and Human Genetics*, *22*, 27-41. https://doi.org/https://doi.org/10.1017/thg.2019.2

Beck, E. D., & Jackson, J. J. (2022). A mega-analysis of personality prediction: Robustness and boundary conditions. *Journal of Personality and Social Psychology*, *122*(3), 523-553. https://doi.org/10.1037/pspp0000386

Chapman, B. P., & Elliot, A. J. (2019). Brief report: How short is too short? An ultra-brief measure of the big-five personality domains implicates "agreeableness" as a risk for all-cause mortality. *Journal of Health Psychology*, *24*(11), 1568-1573. https://doi.org/10.1177/1359105317720819

Costa, P. T., Jr., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Psychological Assessment Resources.

Costa, P. T., Jr., & McCrae, R. R. (1995). Domains and facets: Hierarchical personality assessment using the Revised NEO Personality Inventory. *Journal of Personality Assessment*, *64*(1), 21-50. https://doi.org/10.1207/s15327752jpa6401_2

Čukić, I. (2015). *Personality traits and health outcomes: An exploration into associations and potential mechanisms* The University of Edinburgh]. Edinburgh, United Kingdom. https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.693644

Digman, J. M. (1990). Personality structure: Emergence of the Five-Factor Model. *Annual Review of Psychology*, *41*, 417-440. https://doi.org/10.1146/annurev.ps.41.020190.002221

Eysenck, S. B. G., Eysenck, H. J., & Barrett, P. (1985). A revised version of the Psychoticism scale. *Personality and Individual Differences*, *6*(1), 21-29. https://doi.org/10.1016/0191-8869(85)90026-1

Gale, C. R., Čukić, I., Batty, G. D., McIntosh, A. M., Weiss, A., & Deary, I. J. (2017). When is higher neuroticism protective against death? Findings from UK Biobank. *Psychological Science*, *28*(9), 1345-1357. https://doi.org/10.1177/0956797617709813

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Lawrence Erlbaum Associates.

Gow, A. J., Whiteman, M. C., Pattie, A., & Deary, I. J. (2005). Goldberg's 'IPIP' Big-Five factor markers: Internal consistency and concurrent validation in Scotland. *Personality and Individual Differences*, *39*(2), 317-329. https://doi.org/https://doi.org/10.1016/j.paid.2005.01.011

Grice, J. W. (2001). Computing and evaluating factor scores. *Psychological Methods*, *6*, 430-450.

Harman, H. H., & Jones, W. H. (1966). Factor analysis by minimizing residuals (minres). *Psychometrika*, *31*(3), 351-368. https://doi.org/10.1007/BF02289468

Hill, W. D., Weiss, A., Liewald, D., Davies, G., Porteous, D. J., Hayward, C., McIntosh, A. M., Gale, C. R., & Deary, I. J. (2019). Genetic contributions to two special factors of neuroticism are associated with affluence, higher

intelligence, better health, and longer life. *Molecular Psychiatry*, *25*. https://doi.org/10.1038/s41380-019-0387-3

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, *6*(2), 65-70. http://www.jstor.org/stable/4615733

Jennrich, R. I., & Bentler, P. M. (2011). Exploratory bi-factor analysis. *Psychometrika*, *76*(4), 537-549. https://doi.org/10.1007/s11336-011-9218-4

Jennrich, R. I., & Bentler, P. M. (2012). Exploratory bi-factor analysis: The oblique case. *Psychometrika*, *77*(3), 442-454. https://doi.org/10.1007/s11336-012-9269-1

Jokela, M., Batty, G. D., Nyberg, S. T., Virtanen, M., Nabi, H., Singh-Manoux, A., & Kivimäki, M. (2013). Personality and all-cause mortality: Individual-participant meta-analysis of 3,947 deaths in 76,150 adults. *American Journal of Epidemiology*, *178*(5), 667-675. https://doi.org/10.1093/aje/kwt170

Korten, A. E., Jorm, A. F., Jiao, Z., Letenneur, L., Jacomb, P. A., Henderson, A. S., Christensen, H., & Rodgers, B. (1999). Health, cognitive, and psychosocial factors as predictors of mortality in an elderly community sample. *Journal of Epidemiology and Community Health*, *53*, 83-88. https://doi.org/10.1136/jech.53.2.83

Lahey, B. B. (2009). Public health significance of neuroticism. *The American psychologist*, *64*(4), 241-256. https://doi.org/10.1037/a0015309

Lyon, K. A., Elliott, R., Ware, K., Juhasz, G., & Brown, L. J. E. (2021). Associations between facets and aspects of big five personality and affective disorders: A systematic review and best evidence synthesis. *Journal of Affective Disorders*, *288*, 175-188. https://doi.org/10.1016/j.jad.2021.03.061

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods*, *4*(1), 84-99. https://doi.org/10.1037/1082-989X.4.1.84

McCrae, R. R., & Costa, P. T., Jr. (2010). *NEO Inventories professional manual*. Psychological Assessment Resources.

Nagel, M., Watanabe, K., Stringer, S., Posthuma, D., & van der Sluis, S. (2018). Item-level analyses reveal genetic heterogeneity in neuroticism. *Nature Communications*, *9*(1), 905. https://doi.org/10.1038/s41467-018-03242-8

R Core Team. (2022). *R: A language and environment for statistical computing*. In R Foundation for Statistical Computing. https://www.r-project.org/

Revelle, W. (2023). *psych: Procedures for personality and psychological research*. In (Version 2.2.9) https://CRAN.R-project.org/package=psych

Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives on Psychological Science*, *2*(4), 313-345. https://doi.org/10.1111/j.1745-6916.2007.00047.x

Soto, C. J., & John, O. P. (2017a). The next Big Five Inventory (BFI-2): Developing and assessing a hierarchical model with 15 facets to enhance bandwidth, fidelity, and predictive power. *Journal of Personality and Social Psychology*, *113*(1), 117-143. https://doi.org/10.1037/pspp0000096

Soto, C. J., & John, O. P. (2017b). Short and extra-short forms of the Big Five Inventory–2: The BFI-2-S and BFI-2-XS. *Journal of Research in Personality*, *68*, 69-81. https://doi.org/10.1016/j.jrp.2017.02.004

ten Berge, J. M. F., Krijnen, W. P., Wansbeek, T., & Shapiro, A. (1999). Some new results on correlation-preserving factor scores prediction methods. *Linear Algebra and its Applications*, *289*, 311-318.

Weiss, A. (2024). Data and code related to: Neuroticism phenotypes related to health and the Five-Factor Model of personality's domains and facets. https://doi.org/10.17605/OSF.IO/VN6AD

Weiss, A., & Costa, P. T., Jr. (2014). Re: "Personality and all-cause mortality: Individual-participant meta-analysis of 3,947 deaths in 76,150 adults". *American Journal of Epidemiology*, *179*, 791-792. https://doi.org/10.1093/aje/kwt300

Weiss, A., Gale, C. R., Čukić, I., Batty, G. D., McIntosh, A. M., & Deary, I. J. (2019). Conditioning on a collider may or may not explain the relationship between lower neuroticism and premature mortality in the study by Gale et al. (2017): A reply to Richardson, Davey Smith, and Munafò (2019). *Psychological Science*, *30*(4), 633-638. https://doi.org/10.1177/0956797619833325

Weston, S. J., & Jackson, J. J. (2018). The role of vigilance in the relationship between neuroticism and health: a registered report. *Journal of Research in Personality*, *73*, 27-34. https://doi.org/10.1016/j.jrp.2017.10.005

Wilson, R. S., Krueger, K. R., Gu, L., Bienias, J. L., Mendes de Leon, C. F., & Evans, D. A. (2005). Neuroticism, Extraversion, and mortality in a defined population of older persons. *Psychosomatic Medicine*, *67*(6). https://doi.org/10.1097/01.psy.0000190615.20656.83

Zhu, H. (2021). *kableExtra: Construct complex table with 'kable' and pipe syntax*. In (Version 1.3.4) https://CRAN.R-project.org/package=kableExtra