Personality Facets and Intelligence: Compensation and Investment

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Abstract

This paper revisits the issue of the relationship between personality (the Big Five traits), measured at domain and facet level, and intelligence using two general measures of intelligence. The samples under investigation were over 14,000 adults who were all middle-aged business people attending Assessment Centres in Great Britain. It focused on trying to resolve inconsistent findings by focusing on facet level analyses, using large adult populations and two measures of intelligence. It also explored the *Compensation* hypothesis associated with Conscientiousness, and the *Investment* hypothesis associated with Openness-to-Experience. Correlational results are reported for both males and females and which were very consistent, as well as regression results. At the domain level the results were consistent: four traits, particularly Conscientiousness, were negatively associated with the IQ test scores, while Openness was positively associated. Both studies showed many similar results at the facet level, with facets of the same trait often being strongly positively (O5), but also negatively (O2), associated with intelligence. Overall, effect sizes suggest that personality accounted for relatively little of the variance in intelligence scores: though Openness and its facets showed consistent correlations. Results are discussed in terms of the two prominent mini-theories that link personality traits to intelligence. Limitations of various aspects of this study and implications are discussed.

Keywords

Personality, Intelligence, Facets, Compensation, Investment

1. Introduction

There is a long-standing interest between the two basic "streams" of differential psychology, namely personality and intelligence (DeYoung, 2020). Whilst these two areas of psychology have largely separated, many early researchers, like Cat-

tell and Eysenck embraced both in their theorising and test development (Ackerman & Heggestad, 1997; Eysenck, 1998; Cattell, 1971; Chamorro-Premuzic & Furnham, 2004, 2006; DeYoung, 2011; Zeidner & Matthews, 2000). Both developed theories that described the nature of the relationship and Cattell's famous 16PF test actually contained items measuring fluid intelligence (called Reasoning Ability).

Since the millennium however there have been a number of new studies and ideas in this area, yet there still remains no agreed opinion on the nature of that relationship (Bédard & Le Corff, 2020; Bardach et al., 2023). There are now both large scale studies and meta-analyses that show significant relations between intelligence and some personality traits and researchers have developed theories as to why certain traits (e.g. Conscientiousness, Openness) should be, and are, related to intelligence (Chamorro-Premuzic, 2007; Cuppello et al., 2023; Rammstedt et al., 2018). In a recent meta analysis Anglim et al. (2022) concluded that a analysis at the facet level explained more than twice the variance of domains. In this study we examine the relationship at both domain and facet level.

One reason for the disagreement and equivocal results is that there have been inevitably wide differences in studies with regard to the size and representativeness of the sample tested, but also, perhaps more importantly, the nature of the tests used. Most studies have had a population in the low 100's and a few have really representative samples, restricting populations to students or those in assessment centers (Furnham, 2017; Furnham & Treglown, 2018). It is not only the size of the sample that leads to a restriction of range, as most available samples, such as the one in this study, has systematic sampling biases that can have a powerful influence on the results. It is almost impossible to get a large representative sample to test these hypotheses on.

There has been less debate about the nature of the intelligence test used, given a general agreement that all validated tests are reasonable measures of "g" (general intelligence). However debate about what particular tests are measuring continues (Ackerman, 2023). Reeve and Blacksmith (2009) argued and demonstrated that a clear understanding of intelligence–personality associations requires the variance due to "g" to be separated from the variance due to narrow cognitive abilities. In other words, it is important, where possible to use and explore facets of "g", particularly separating crystalised and fluid intelligence. This however can only be done by using IQ test batteries that have many subscales.

Many different personality tests have been used in this research area including some of the best known: EPQ, 16PF, NEO-PI-R, but also a range of other tests (Chamorro-Premuzic, 2007). This may be a part explanation as it is known that while different tests that measure the same trait (i.e., Extraversion) and total scores are relatively highly correlated (usually .45 > r < .65), they might be assessing rather different features of that trait (i.e., sociability, optimism, impulsivity) which can be best seen at the facet level. Thus, it may be that some measures of Extraversion stress impulsivity as well as sociability, while others place more

emphasis on positive emotions (Furnham, 2008). Hence the difference between correlational results between domain trait extraversion and IQ using different tests of the former but not the latter.

In a highly relevant study to this one Rammstedt et al. (2018) investigate the associations between both fluid and crystallized intelligence with Big Five personality domains and facets in an adult German population (N = 365). They found personality was more strongly related to crystallized intelligence than to fluid intelligence. More importantly the facets explained a larger share of variance in both crystallized and fluid intelligence than did domains and the associations of different facets of the same domain trait with IQ differed, often quite markedly.

There are, however, some specific mini-theories about the overlap between two particular traits and intelligence which attempt to explain often replicated results.

1.1. Compensation Theory

One of the most explored ideas is *Compensation theory* which states that Conscientiousness acts as a "coping/reimbursing strategy" for less intelligent, but ambitious and competitive people (Murray et al., 2014). It is a way of coping in a competitive environment: for those who are less intelligence have to work harder than those who are brighter to achieve the same results. According to this theory, relatively less intelligent individuals may become more methodical, organised, thorough, and persistent (i.e., conscientious) to compensate for their relative lack of intelligence particularly in a highly competitive educational or work environment. That is, they can achieve as much as bright people by simply working harder. Alternatively, relatively more intelligent people may tend to get by on their cognitive efficiency rather than strenuous effort or persistent organisation.

Earlier Moutafi et al. (2004) sought to clarify the negative relationships found between Conscientiousness and intelligence by distinguishing between fluid (gf) and crystallised (gc) intelligence correlations with Conscientiousness (Cattell, 1971). They argued that if Conscientiousness was more strongly correlated with fluid than crystallised intelligence, it indicated that the direction of causality in the relationship between intelligence and Conscientiousness must be that intelligence affects the development of Conscientiousness. This was because fluid intelligence represents a more genetically based measure of intelligence, which makes it less environmentally influenced than the more experience dependent crystallised intelligence. As predicted, Moutafi et al.'s (2004) investigation found Conscientiousness to be more highly negatively correlated with fluid than crystallised intelligence, which was consistent with their theory. However it should be acknowledged that many measures of crystalised intelligence are verbal and just as heritable as fluid intelligence after controlling for g (Johnson et al., 2008).

However, Wood and Englert (2009) did not replicate the results. In their study

fluid and crystallised intelligence were assessed via the General Reasoning Test Battery 2. Two personality inventories were employed: The Fifteen-Factor Questionnaire and the Occupational Personality Profile. 15FQ subfactors of Conscientious and Discipline negatively correlated with fluid *and* crystallised intelligence. OPP subfactors of Detail-Conscious and Conformity also negatively correlated with fluid *and* crystallised intelligence. Subfactors for both personality measures correlated more strongly with crystallised than fluid intelligence. One explanation for the different results occurs because of subtle difference in the measures of Conscientiousness: which is indeed the whole point of measuring traits at the facet and domain level.

Also, it should be noted that different domain measures of Consciousness have very different facets. Thus Conscientiousness, called *Prudence* in the Hogan Personality Inventory, has 7 facets: Moralistic (Adhering strictly to conventional values); Mastery (Being hard-working); Virtuous (Being perfectionistic); Not Autonomous (Concern about others' opinions of oneself); Not Spontaneous (Preference for predictability); Impulse Control (Lack of impulsivity; and Avoids Trouble (Hogan et al., 2007). These are quite different from those in the HEXACO which are Organization (a tendency to seek order, particularly in one's physical surroundings); Diligence (a tendency to hard work); Perfectionism (a tendency to be thorough and concerned with details); and Prudence (consistently and deliberately inhibiting impulses).

One question that we have in this study is which facets of Conscientiousness, as measured by the most well-used measure in the area, namely the NEO-PI-R, are most related to IQ, which may give some insight into the mechanism/process that determines that relationship.

1.2. Investment Theory

Others have argued that Openness is, and should be, most closely related to intelligence. DeYoung et al. (2014) hypothesized, and found, that only aspects from the Openness-to-Experience domain should be empirically associated with intelligence, with the Intellect facet being more strongly associated with intelligence than its counterpart aspect, Openness. This study was replicated by Bédard and Le Corff (2020) who found that the Intellect facet was independently associated with g, verbal, and nonverbal intelligence, while its domain Openness was independently related to verbal intelligence only.

Von Stumm (2018) proposed an Investment Theory of adult intelligence which posits that individual differences in knowledge attainment results from people's differences in cognitive ability *and* their propensity to apply and invest that ability. These she refers to as investment personality traits. Von Stumm and Ackerman (2013) identified 34 trait constructs and corresponding scales that refer to intellectual investment which were classified into different trait categories. These include Intellectual Curiosity, Abstract Thinking, Openness, Absorption, Ambiguity, Novelty Seeking and Social Curiosity. In their meta-analysis of 112

studies with an overall sample of 60,097 participants they found investment traits were mostly positively associated with adult intellect markers ranging from r = .0 to r =.58, with an average estimate of .30. They concluded that the strength of investment-intellect associations differs across trait scales and markers of intellect.

Again, a question that we have in this study is which facets on Openness are most related to IQ, which may give some insight into the mechanism/process that determines that relationship. We explore this with simple correlational and regression analyses.

1.3. This Study

There are at least three ways to advance this literature. The first is to use facet, as well as domain, measures of personality. Studies done at the facet, as opposed to domain level have tried to examine the jingle-jangle fallacy in this area. For instance, Schmidt et al. (2020) showed the relationships with external criteria of Grit's facets were similar in direction and size to those of the Conscientiousness facets, hence that Grit's facets can be subsumed under domain Conscientiousness. The second to use more than one test of IQ to find evidence of replicability: that is to see whether the size and direction of the correlations are similar across different tests and different populations. The third is to test large, adult populations so that there is a good distribution of scores on all the variables, however we have to acknowledge that because of the sampling the estimates of the relations between the two variables will not necessarily generalise to the population as a whole.

We also looked at sex differences in this study for two reasons. First there is a lively debate about sex differences in both personality and intelligence and hence their relationship to each other, and second because it was a simple way to split the large samples to look at the issue of replication (Furnham, 2008, 2017). However, it should be acknowledged that splitting samples by sex does not allow for replication in the typical sense because the subsamples may then differ systematically.

We expected to replicate studies at the domain level: namely that Conscientiousness and Neuroticism would be negatively and Openness positively associated with both our measures of intelligence. However, we were most interested in the facet analysis, particularly where facets were very differently associated with the intelligence test score.

2. Method

2.1. Participants

Group 1: In all there were 7156 men and 2091 women. Their average age was 37.72 yrs (SD = 12.48). Nearly all were managers in various sectors like finance, technology, engineering and human resources. Just under 90% identified as white and 88% as British. Around 3/4 were graduates.

Group 2: In all there were 3802 men and 1017 women. Their average age was

35.11yrs (SD = 9.18). Nearly all were managers in various sectors like finance, technology, engineering and human resources. Just over 90% identified as white and 94% as British. Around 3/4 were graduates.

2.2. Measures

1) *Revised NEO Personality Inventory* (NEO PI-R; Costa & McCrae, 1992). The NEO PI-R is a 240-item measure of the Five-Factor Model of personality. The inventory is composed of self-descriptive statements to which respondents use a 5-point Likert-type scale to determine to what extent they agree with each statement (1 = Strongly disagree, 5 = Strongly agree). The NEO PI-R measures the five factors of personality (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience) as well as six subordinate dimensions (or "facets") of each of the Big Five personality factors. The NEO PI-R manual (Costa & McCrae, 1992) provides extensive evidence of both reliability and validity, and the measure is perhaps the most widely used personality test in occupational research (Furnham, 2008).

2) *Graduate and Managerial Assessment: Abstract* (GMA: A; Blinkhorn, 1985). This is a timed (30 minutes) high-level test of abstract reasoning ability, measuring the ability to think conceptually, to discover underlying patterns within sets of information, and to switch easily between contexts and level of analysis. The test is composed of 115 questions split into 23 groups of five questions each. There are two different scoring methods, namely the "lenient" score (GMA-L) which measures the total number of correct items, and the "harsh" score (GMA-H), in which a mark is assigned for each group of five questions that are answered correctly. In the present, the two scores were very highly inter-correlated (r = .97, p < .001), and so we only report results for GMA-H.

3) *The Watson–Glaser Critical Thinking Appraisal* (WGCTA; Watson & Glaser, 1980). This is a timed (40 min) ability test assessing the ability to define a problem, to select pertinent information for its solution, to recognise stated or unstated assumptions, to formulate and select hypotheses and to draw valid conclusions. The test consists of five subtests: a) The Inference test consists of three statements, each followed by a number of proposed assumptions. Participants have to discriminate among degrees of truth or falsity of the assumptions based on the given data. b) The Recognition of Assumptions test consists of five statements, each followed by several proposed assumptions. Participants have to decide for each assumption whether a person, in making the given statement, is really making that assumption. c) The Deduction test consists of six statements, each followed by several assumptions. Participants have to determine whether certain conclusions necessarily follow from the information given in the statements. d) The Interpretation test consists of five short paragraphs, each followed by several conclusions. Participants have to decide whether the given conclusions logically follow beyond a reasonable doubt from the information given in the paragraph. e) The evaluation of arguments test consists of five questions,

each followed by several arguments. Subtests scores are highly intercorrelated and total score calculated. Participants have to distinguish between strong and weak arguments. Studies on the WGCTA have provided evidence for the test's reliability and validity (Watson & Glaser, 1980).

2.3. Procedure

Participants were tested by a British based psychological consultancy over a 14-year period. Every year the file grew as more people took the tests. They took these and other tests as part of an assessment exercise, run under strict guidelines as set out by the BPS. They were tested, in small groups, over a half day period with breaks between tests. They were all tested at a designed facility in south east England. Tests were administered in the same order, by the same small group of people, all certified work psychologists over this whole period.

Each participant was given personal detailed feedback on their score on all tests. They were nearly all employed as middle to senior managers in British companies. They agreed to their anonymised data being analysed and the results reported to further the understanding of assessment and selection. However, we had no more data than their sex, age, occupational sector and when they were tested.

In this study we used two different groups of participants who completed the same personality but different intelligence tests. A sub-group of just of 3131 people completed both tests and they were added to both samples.

3. Results

Tables 1-7 were from the first sample and test and Tables 8-14 from the second sample and test. All Tables show both correlational (separate for males, coded 1 and females coded 2) and a multiple regression. The N's varied slightly (by around 2% - 5%) in the different analyses due to missing data.

Table 1. Regression with gender and **NEO PI-R scores**.

	B	SE	Beta	t	GMA Male r	GMA Female r
Gender	.387	.075	.051	5.143**		
Neuroticism	−.011	.002	−.068	−5.939**	.001	.027
Extraversion	−.013	.002	−.074	−6.486**	−.043***	−.024
Openness	.017	.002	.101	9.361**	.069***	.090***
Agreeableness	−.004	.002	−.018	−1.819	−.014	−.048*
Conscientiousness	−.021	.002	−.116	−10.577**	−.114***	−.088***
Adjusted R^2				.025		
F				46.945		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 2. Regression with gender and all **30 facets**.

	B	*SE*	Beta	*t*	GMA Male *r*	GMA Female *r*
Gender	.643	.077	.084	8.402**		
N1 Anxiety	−.024	.009	−.040	−2.824**	−.030**	−.011
N2 Hostility	−.029	.009	−.041	−3.044**	−.045***	.008
N3 Depression	−.020	.010	−.029	−1.882	−.006	.016
N4 Self-Consciousness	.044	.010	.059	4.510**	.038***	.021
N5 Impulsiveness	.015	.009	.022	1.770	.034**	.052*
N6 Vulnerability	.058	.014	.064	4.204**	.027*	.058**
E1 Warmth	−.060	.012	−.076	−4.939**	−.076***	−.003
E2 Gregariousness	−.021	.009	−.032	−2.499*	−.068***	−.019
E3 Assertiveness	−.002	.010	−.002	−.178	−.048***	−.034
E4 Activity	.012	.010	.016	1.236	−.037**	−.028
E5 Excitement-Seeking	.014	.008	.020	1.759	.037**	−.006
E6 Positive Emotions	.011	.009	.017	1.258	−.008	−.013
O1 Fantasy	−.018	.008	−.027	−2.312*	.053***	.051*
O2 Aesthetics	−.065	.006	−.122	−10.122**	−.025*	−.007
O3 Feelings	.005	.010	.006	.474	−.045***	−.040
O4 Actions	.017	.009	.022	1.923	.052***	.058**
O5 Ideas	.142	.007	.236	20.034**	.166***	.144***
O6 Values	.050	.009	.055	5.293**	.089***	.098***
A1 Trust	.052	.009	.068	5.917**	.041***	.052*
A2 Straightforward	−.012	.008	−.018	−1.555	−.015	−.035
A3 Altruism	−.004	.012	−.005	−.363	−.041***	−.057**
A4 Compliance	.028	.010	.036	2.870**	.043***	−.039
A5 Modesty	−.031	.007	−.045	−4.125**	−.041***	−.060**
A6 Tendermindedness	−.050	.010	−.055	−5.022**	−.051***	−.052*
C1 Competence	.003	.014	.003	.228	−.038***	−.045*
C2 Order	−.023	.008	−.033	−2.817**	−.112***	−.084***
C3 Dutifulness	.039	.012	.043	−3.255**	−.061***	−.050*
C4 Achievement	−.071	.011	−.088	−6.305**	−.108***	−.067**
C5 Self-Discipline	−.034	.012	−.044	−2.962**	−.105***	−.075***
C6 Deliberation	−.019	.009	−.026	−2.069*	−.063***	−.062**
Adjusted R^2				.084		
F				32.888		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .00$.

Table 3. Regression with gender and the six facets of **Neuroticism**.

	B	*SE*	Beta	*t*	GMA Male *r*	GMA Female *r*
Gender	.420	.086	.054	4.858***		
N1	−.040	.010	−.066	−4.020***	−.030**	−.011
N2	−.042	.009	−.061	−4.569***	−.045***	.008
N3	−.015	.012	−.022	−1.254	−.006	.016
N4	.044	.011	.059	4.023***	.038***	.021
N5	.046	.009	.065	5.366***	.034**	.052*
N6	.057	.014	.064	4.153***	.027*	.058**
Adjusted R^2				.013		
F				16.158		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 4. Regression with gender and the six facets of **Extraversion**.

	B	*SE*	Beta	*t*	GMA Male *r*	GMA Female *r*
Gender	.562	.088	.072	6.358***		
E1	−.036	.012	−.046	−2.931**	−.076***	−.003
E2	−.036	.010	−.054	−3.670***	−.068***	−.019
E3	−.015	.010	−.021	−1.584	−.048***	−.034
E4	−.005	.010	−.006	−.445	−.037**	−.028
E5	.044	.009	.062	4.949***	.037**	−.006
E6	.016	.010	.024	1.623	−.008	−.013
Adjusted R^2				.011		
F				13.822		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 5. Regression with gender and the six facets of **Openness**.

	B	*SE*	Beta	*t*	GMA Male *r*	GMA Female *r*
Gender	.637	.086	.082	7.360***		
O1	.023	.008	.036	2.813**	.053***	.051*
O2	−.070	.007	−.133	−9.891***	−.025*	−.007
O3	−.034	.009	−.045	−3.583***	−.045***	.040
O4	−.011	.009	−.015	−1.206	.052***	.058**
O5	.128	.008	.212	16.344***	.166***	.144***
O6	.062	.011	.067	5.711***	.089***	.098***
Adjusted R^2				.048		
F				60.615		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 6. Regression with gender and the six facets of **Agreeableness**.

	B	*SE*	Beta	*t*	GMA Male *r*	GMA Female *r*
Gender	.543	.086	.070	6.297***		
A1	.060	.009	.078	6.305***	.041***	.052*
A2	−.003	.009	−.005	−.377	−.015	−.035
A3	−.050	.012	−.054	−4.201***	−.041***	−.057**
A4	.030	.010	.039	3.034**	.043***	−.039
A5	−.026	.008	−.037	−3.090**	−.041***	−.060**
A6	−.047	.011	−.051	−4.122***	−.051***	−.052*
Adjusted R^2				.014		
F				17.212		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 7. Regression with gender and the six facets of **Conscientiousness**.

	B	*SE*	Beta	*t*	GMA Male *r*	GMA Female *r*
Gender	.470	.085	.061	5.509***		
C1	.054	.015	.055	3.694***	−.038***	−.045*
C2	−.053	.009	−.076	−5.753***	−.112***	−.084***
C3	.030	.013	.033	2.254*	−.061***	−.050*
C4	−.053	.011	−.066	−4.660***	−.108***	−.067**
C5	−.045	.013	−.058	−3.550***	−.105***	−.075***
C6	−.026	.009	−.036	−2.850**	−.063***	−.062**
Adjusted R^2				.021		
F				26.378		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 8. Regression with gender and **NEO PI-R scores**.

	B	*SE*	Beta	*t*	WG Male *r*	WG Female *r*
Gender	−.616	.122	−.078	−5.040***		
NEO N	−.014	.003	−.084	−4.735***	−.084**	.004
NEO E	−.008	.003	−.043	−2.425*	−.005	−.009
NEO O	.017	.003	.096	5.626***	.148***	.106**
NEO A	−.009	.003	−.043	−2.802**	009	−.053
NEO C	−.026	.003	−.141	−8.331***	−.062**	−.102**
Adjusted R^2				.032		
F				25.347		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 9. Regression with gender and all **30 facets**.

	B	*SE*	Beta	*t*	WG Male *r*	WG Female *r*
Gender	−.832	.126	−.106	−6.614***		
NEO N1	−.028	.014	−.044	−2.025*	−.099***	−.044
NEO N2	−.033	.015	−.046	−2.192*	−.093***	.053
NEO N3	−.029	.17	−.040	−1.699	−.089***	−.035
NEO N4	.034	.016	.044	2.134*	−.063**	−.020
NEO N5	.021	.014	.029	1.496	.016	.095**
NEO N6	.050	.022	.053	2.244*	−.028	−.025
NEO E1	−.031	.020	−.037	−1.567	−.028	−.021
NEO E2	−.032	.014	−.046	−2.317*	−.052**	−.030
NEO E3	−.011	.015	−.015	−.691	.030	.009
NEO E4	.030	.016	.038	1.920	.066**	.041
NEO E5	.023	.014	.032	1.776	−.018	−.017
NEO E6	−.005	.015	−.007	−.343	−.011	−.019
NEO O1	−.009	.013	−.013	−.678	.101***	.068
NEO O2	−.054	.010	−.102	−5.375***	.017	.010
NEO O3	.013	.016	.017	.864	.027	.069
NEO O4	.021	.014	.027	1.461	.112***	.004
NEO O5	.121	.011	.195	10.576***	.204***	.096**
NEO O6	.066	.000	.000	.029	.031	.206***
NEO A1	.056	.014	.071	4.030***	.117***	.081*
NEO A2	−.023	.013	−.032	−1.829	052**	−.021
NEO A3	.003	.019	.003	.144	−.056**	−.081*
NEO A4	.013	.016	.017	.847	−.005	−.115**
NEO A5	−.045	.012	−.063	−3.662***	−.032	−.028
NEO A6	−.055	.016	−.059	−3.416**	−.060	−.078*
NEO C1	−.003	.022	−.003	−.126	.028	.025
NEO C2	−.042	.013	−.059	−3.240**	−.178***	−.140***
NEO C3	.037	.019	.041	1.981*	.004	−.028
NEO C4	−.069	.018	−.085	−3.923***	.013	−.047
NEO C5	−.048	.019	−.060	−2.584*	−.058**	−.082*
NEO C6	−.012	.015	−.016	−.808	−.044*	−.132***
Adjusted R^2				.075		
F				12.400		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 10. Regression with gender and the six facets of NEO **Neuroticism**.

	B	SE	Beta	t	WG Male r	WG Female r
Gender	−.616	.119	−.078	−5.155***		
NEO N1	−.052	.014	−.082	−3.813***	−.099***	−.044
NEO N2	−.038	.013	−.053	−2.936**	−.093***	.053
NEO N3	−.024	.016	−.034	−1.458	−.089***	−.035
NEO N4	.029	.015	.038	1.934	−.063**	−.020
NEO N5	.054	.012	.073	4.469***	016	.095**
NEO N6	.074	.019	.078	3.826***	−.028	−.025
Adjusted R^2				.017		
F				12.137		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 11. Regression with gender and the six facets of NEO **Extraversion**.

	B	SE	Beta	t	WG Male r	WG Female r
Gender	−.726	.123	−.092	−5.902***		
NEO E1	−.017	.017	−.021	−.973	−.028	−.021
NEO E2	−.043	.014	−.061	−3.083**	−.052**	−.030
NEO E3	−.015	.013	−.020	−1.089	.030	.009
NEO E4	.007	.015	.009	.478	.066**	.041
NEO E5	.054	.012	.075	4.381***	−.018	−.017
NEO E6	.012	.014	.018	.881	−.011	−.019
Adjusted R^2				.012		
F				8.913		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 12. Regression with gender and the six facets of NEO **Openness**.

	B	SE	Beta	t	WG Male r	WG Female r
Gender	−.720	.121	−.091	−5.940***		
NEO O1	.035	.012	.052	2.995**	.101***	.068
NEO O2	−.065	.010	−.121	−6.561***	.017	.010
NEO O3	−.024	.013	−.031	−1.810	.027	.069
NEO O4	.016	.013	.021	1.251	.112***	.004
NEO O5	.111	.011	.180	10.060***	.204***	.096**
NEO O6	.001	.000	.001	.039	.031	.206***
Adjusted R^2				.038		
F				25.476		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 13. Regression with gender and the six facets of NEO **Agreeableness**.

	B	SE	Beta	t	WG Male r	WG Female r
Gender	−.750	.120	−.095	−6.262***		
NEO A1	.060	.013	.076	4.567***	.117***	.081*
NEO A2	−.014	.013	−.019	−1.120	.052**	−.021
NEO A3	−.033	.16	−.036	−2.064*	−.056**	−.081*
NEO A4	.026	.014	.032	1.848	−.005	−.115**
NEO A5	−.044	.012	−.062	−3.742***	−.032	−.028
NEO A6	−.049	.016	−.053	−3.103**	−.060	−.078*
Adjusted R^2				.018		
F				12.506		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 14. Regression with gender and the six facets of NEO **Conscientiousness**.

	B	SE	Beta	t	WG Male r	WG Female r
Gender	−.687	.118	−.087	−5.810***		
NEO C1	.057	.020	.056	2.830**	.028	.025
NEO C2	−.067	.013	−.093	−5.197***	−.178***	−.140***
NEO C3	.010	.018	.011	.583	.004	−.028
NEO C4	−.040	.016	−.049	−2.528*	.013	−.047
NEO C5	−.047	.018	−.058	−2.545**	−.058**	−.082*
NEO C6	−.021	.013	−.028	−1.600	−.044*	−.132***
Adjusted R^2				.027		
F				18.183		
p				.000		

*$p < .05$, **$p < .01$, ***$p < .001$.

The results show first, the size of the correlation may be significant but they were very low indeed, with minimal effect sizes; second there was both evidence for Compensation and Investment theory.

These results again show very low, if significant correlations, few exceeding $r > .10$. The pattern of results between the two sexes seemed consistent. The facets of Openness seemed most strongly, but most inconsistently, related to the intelligence score.

Results suggested that the facets of Neuroticism were inconsistently and little related to the IQ score.

As with the above regression the results suggested that facets were inconsistently and were little related to the IQ score.

There were two striking results from the analysis in Table 5. The first was that

half the association were positive and the other negative and that two facets O2 (Aesthetics) and O5 (Ideas) were most strongly related to IQ.

As with many of the above tables both analyses showed some facets positively and others negatively associated with intelligence, but both were very low indeed: i.e. explaining around one percent of the variance

Compared to the above analyses this showed the facets of Conscientiousness were most strongly and consistently negatively associated with the IQ score.

These results provide support for both Compensation and Investment theory

Both correlational and regression analysis shows relatively few of the correlations were significant, particularly for females. The facet O5 (Ideas) is clearly the strongest correlate of the IQ score.

The results suggest little or no evidence for any relationship between the extraversion facets and the IQ score.

These results were particularly interesting as one facet (O5) already identified in the above analyses was moderately associated with the IQ score (particularly for males).

The correlational results suggested that one facet (A1: Trust) was positively associated with the intelligence score.

This analysis suggested three facets on Conscientiousness (C2: Order) and C5 (Self Discipline) and C6 (Deliberation) were negatively associated with the IQ score.

All the above tables show both correlational (separate for males and females) and a multiple regression. The N's varied slightly in the different analyses due to missing data. Thus, we were able to look at the consistency of the associations with analyses on two IQ tests separated by gender.

3.1. Domain Level Analysis

If the results of Tables 1-8 and are compared they are strikingly similar. We show correlations for males and females and the regression for the total sample. What is clear is the consistent relationship between Openness and Conscientiousness for both sexes in both tests.

With regard to the regressions both analyses showed only 3% of the variance is accounted for, and in both, gender was significant: males scored higher than females. Four of the five traits were negatively associated with the IQ score with the exception being Openness, which was positively associated. Supplementary regressions (inverse, quadratic) not reported here, were performed as it has been suggested that relationships between personality and ability may be non-linear: none was essentially better than the solution found in the linear model.

3.2. Facet Level Analysis

If Tables 2-9 are compared these show the results of regressing gender and all 30 facets onto the two IQ scores. Again, the results are reasonably comparable. In both regressions, 02 (Aesthetics) and C4 (Achievement Striving) were strongly

negatively and 05 (Ideas) and 06 (Values) positively correlated with the IQ scores.

When the separate Big Five facets were regressed separately again the results were comparable. For Neuroticism (Table 3 and Table 10) both N1 (Anxiety) and N2 (Angry Hostility) were negatively and N5 (Impulsiveness) and N6 (Vulnerability) positively associated with the IQ scores. For Extraversion (Table 4 and Table 11), E2 (Gregariousness) was negatively and E4 (Activity) positively associated with the IQ scores. For Openness in both analyses (Table 5 and Table 12) O2 (Aesthetics) was negatively and O5 (Ideas) positively associated with the IQ scores. For Agreeableness (Table 6 and Table 13) A1 (Trust) was positively and A5 (Modesty) and A6 (Tender-Mindedness) negatively associated with the two IQ scores. Finally, for Conscientiousness (Table 7 and Table 14) C1 (Competence) was positively and C4 (Achievement Striving) and C5 (Self-Discipline) negatively related to the IQ tests.

Correlational results comparing males and females were very consistent. There were very few incidences where the direction of the correlation differed (positive vs negative). Many were very low but significant because of the large N (particularly with the GMA). For both sexes and both IQ tests correlations were highest for O5 and C2. One of the greatest disparities however was apparent in Table 12 where correlations were rather different: for males it was O5 but for females it was O6 that was most positively associated with the IQ score.

4. Discussion

This study finds evidence not always compatible with a number of other studies. First, they showed the association between personality and intelligence to be low. For instance, the correlations between Neuroticism (GMA r = −.02; WG r = −.04), Extraversion (GMA r = −.03; WG r = .00), Openness (GMA r = .08; WG r = .12), Agreeableness (GMA r = −.01; WG r = .02) and Conscientiousness (GMA r = −.11; WG r = −.08) were very low. For instance, in a review paper DeYoung (2020) noted the association between Openness (and particularly the Intellect facet) to be around r = .30, while that between Neuroticism around r = .15 which suggests this may be a non-representative sample. Furthermore, it is not suggested that this is primarily a result of method invariance but that, at a domain level, there is little reason to expect strong and significant associations (DeYoung, 2011). This may explain why these two pillars of differential psychology have been so separated for so long.

There was also evidence however both the domain and facet level that there was for the Compensation theory for Conscientiousness and the Investment theory for Openness. As has been found many times these two traits are related to IQ, albeit with modest correlations. Both theories need longitudinal data to verify the process by which, over time, stable personality traits supposedly influence intelligence, particularly crystallised intelligence. It seems apparent that crystallised, rather than fluid, intelligence is amenable to change and development (Chamorro-Premuzic & Furnham, 2004). Indeed, when the relationship

between these two aspects of intelligence is examined over time, the data suggests a steady decline of fluid, but increase of crystallise intelligence, from mid to late adulthood (i.e. 40 - 80 years). Most people grow in knowledge but decline in information processing speed (Chamorro-Premuzic, 2007).

However, what was more interesting and important in this study was the facet analysis. This allowed some investigation of a more detailed look at which features of a trait seemed to best account for the results. Perhaps the first striking feature of the facet analysis (see Table 2 and Table 9) was that while some facets in the *same* trait were significantly positively, others were significantly negatively associated with the IQ score. There was enough replication between the two measures (and two sexes) to have confidence with the results both when all facets were used in the regression, in addition to when they were done on a trait-by-trait basis. This occurred for both Conscientiousness and Openness which has implications for both Compensation and Investment theory.

The results suggested that of all the facets, O5 (Ideas), and to a lesser extent O6, (Values) were most closely related to IQ, though the effect sizes were small to moderate. The manual gives some clues as to why. It suggests that people who score high on 05 (Ideas) have an active pursuit of intellectual interests, entertain unconventional ideas, and enjoy philosophic arguments and brain teasers. Adjective checklist items associated with this facet are: idealistic, inventive, curious, original, imaginative and insightful. In this sense, these people accumulate knowledge, which could be seen as the essence of crystalised intelligence. O6, on the other hand, is described as being non-dogmatic, ready to examine social, political and religious values. Yet O2, (Aesthetics) was consistently *negatively* associated with IQ and describes high scorers as those who seek out and are often deeply moved by art, music, and poetry. This may be due to a selection effect in this sample whereby less creative people may need to be more intelligent to rise to higher management levels.

It is not clear why the Conscientiousness traits C2 Order (an emphasis on order, neat and tidy), C4 (Achievement Striving) (diligent, ambitious, workaholics) and C5 (Self-Discipline) (completion orientation and tolerance for distraction) are negatively associated with IQ. This may be due to this particular population studied here. The adjective checklist items for C2 (Order) include thorough, efficient, precise, methodological; C4 (Achievement Striving) industrious, determined, persisting, determined and C5 (Self-Discipline) as organised, thorough, efficient, industriousness. Interestingly, many of these traits are valued in many occupations, including academia. However, when we tested the non-linear regression there was no indication that the association was, as some have suggested an inverse U.

There are many limitations to this study. First, because of the nature of the two IQ tests we used we were unable to clearly differentiate between crystalised vs fluid intelligence. Of the two tests the GMA was clearly more fluid in nature, but we did not have a robust measure of crystalised intelligence which may have allowed us to explore the Compensation thesis more clearly. Indeed, there are

often problems associated with measuring "pure" tests if crystalised intelligence as they are often culture-bound

Second, though we did have a large N it was restricted to middle-class, middle-aged professionals which meant that people at the lower ends of the IQ range (<100) were not well represented. It could be argued that this restriction of range had an impact on the results and that the correlations would have been higher has we been able to test a truly representative sample. We examined the distribution of the IQ scores which was normal. We also did a restriction of range correction for the total scores but the results were little changed.

In addition, we would like to have had more information on each of the participants such as their educational achievements as well as the precise nature of their jobs, their physical and mental health as well as their beliefs about their own personality and intelligence.

Critics of the Big Five suggest both that analysis at the facet level is unwise because they do not replicate very well in factor analytic studies. Moreover, that the NEO PR-R model does not measure other important aspects of personality which may be more directly related to personality, though it is not clear what they are. However, given the continued interest it, and testing of both Compensation and Investment theory it remains, as always, best to do longitudinal studies on large representative populations to explore causal relationships, and more importantly seek to understand the processes involved.

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Data Availability

This is obtainable from the first author upon request.

Ethics

This was sought and obtained (UCL: Research Department of Clinical Educational and Health Psychology's Ethics Committee: CEHP/514/2017).

Informed Consent

Participants gave written consent for their anonymised data to be analysed and published.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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