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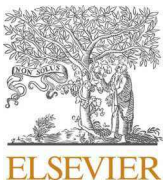

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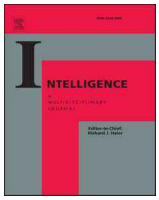

# The claim that personality is more important than intelligence in predicting important life outcomes has been greatly exaggerated

Chen Zisman [a], Yoav Ganzach [b,*]

[a] The Coller School of Management, Tel Aviv University, Israel
[b] Ariel University and the Academic College of Tel-Aviv Yaffo, Israel

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ABSTRACT

We conduct a replication of Borghans, Golsteyn, Heckman and Humphries (PNAS, 2016) who suggested that personality is more important than intelligence in predicting important life outcomes. We focus on the prediction of educational (educational attainment, GPA) and occupational (pay) success, and analyze two of the databases that BGHH used (the NLSY79, $n = 5594$ and the MIDUS, $n = 2240$) as well as four additional databases, (the NLSY97, $n = 2962$, the WLS, $n = 7646$, the PIAAC, $n = 3605$ and the ADD health, $n = 3553$; all databases are American except of the PIAAC which is German). We found that for educational attainment the average $R^2$ of intelligence was .232 whereas for personality it was .053. For GPA it was .229 and .024, respectively and for pay it was .080 and .040, respectively.

## 1. Introduction

Research on individual characteristics as antecedents of important life outcomes has shifted its emphasis over the years. Early on, the main focus was on cognitive antecedents—primarily intelligence—that bring about positive life outcomes, primarily educational and occupational success (e.g. Thorndike & Hagen, 1959; Strenze, 2007. See Herrnstein & Murray, 1994, for a widely cited book in this area). Some researchers even argued that "there is not much more than *g* [i.e., General Mental Ability]" in predicting these outcomes (Ganzach & Patel, 2018; Olea & Ree, 1994; Ree & Earles, 1991; Ree, Earles, & Teachout, 1994). However, in recent years there has been a proliferation of research that emphasized the effects of non-cognitive—mainly personality—individual differences on life outcomes (e.g. Choi & Laschever, 2018; Duckworth et al., 2019; Duckworth & Weir, 2010; Heckman & Kautz, 2012; Judge, Higgins, Thoresen, & Barrick, 1999; Kuhnen & Melzer, 2018; Mosca & McCrory, 2016; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). This recent trend culminated in studies that suggested that, in predicting life-outcomes, personality is more important (i.e. has a higher predictive validity) than intelligence (Borghans, Golsteyn, Heckman, & Humphries, 2016; Duckworth, Peterson, Matthews, & Kelly, 2007; Kappe & Van Der Flier, 2012). Whereas the evidence for the superiority of personality as a predictor of life outcomes was questioned by other studies (Crede, Tynan, & Harms, 2017; Ganzach & Pazy, 2014; Zisman & Ganzach, 2020), questions regarding the relative predictive validity of intelligence and personality are still open questions.

A most important study that argued for the superiority of personality over intelligence as a predictor of important life outcomes was Borghans, Golsteyn, Heckman & Humphries (2016; hereafter BGHH). Since this study reflects the recent trend to de-emphasize the role of intelligence among economists, and because of its high visibility (it was led by Noble prize winner James Heckman and published in one of the most prestigious general science journals), in the current paper we revisit BGHH analyses and compare the predictive power of intelligence and personality, directly examining BGHH's conclusion that "*Personality is generally more predictive than IQ on a variety of important life outcomes*" (see the abstract of BGHH paper, p. 13354).

BGHH approach of comparing the predictive power of intelligence and personality was straightforward. They compared the correlations between intelligence and important life outcomes to the correlations between personality and these outcomes. In our analyses we closely follow this approach. We focus on the big five personality dimensions as measures of personality, because they are central to BGHH work as well as to personality research in general, and because unlike the other personality measures BGHH used, which are specific personality traits, together the big five provide a full description of personality, and are commonly available in representative databases that measure life outcomes. We analyze two of the databases that were analyzed by BGHH

* Corresponding author.
*E-mail address:* yoavgn@post.tau.ac.il (Y. Ganzach).

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(the NLSY79 and the MIDUS), avoiding the analysis of a third dataset, the BCS, because it did not include measures of the big five (a fourth data base BGHH analyzed, the Stela Maris dataset, did not include life outcomes). Instead, we added to our analyses other four large, nationally and internationally representative datasets – the NLSY97, the WLS, the ADD Health and the PIAAC.

In our analyses we focus on educational and occupational success as dependent variables representing life outcomes. Although BGHH included in their analysis, in addition to these outcomes, other outcomes such as depression, physical health, mental health and life satisfaction. One reason was that these four latter outcomes are assessed by subjective measures and therefore their correlations with personality are prone to biases stemming from social desirability, participants' subjective interpretation of the questions, and common method variance associated with the use of rating scales in measuring both the dependent (the four latter outcomes) and the independent variables (the big five). In particular, common method variance may inflate the relationship between measures of personality and measures of subjective outcomes, since both are measured by self-reported rating scales.

It is important to note that BGHH dealt in their paper with two issues. First, with the effects personality versus intelligence on grades and on "achievement tests" (see our discussion below regarding BGHH use of the term achievement tests), and second, with the effects of personality versus intelligence on life outcomes. Our focus in this paper is on the second issue. With regard to the first issue, BGHH position is that "Personality is relatively more important in predicting grades than scores on achievement tests. IQ is relatively more important in predicting scores on achievement tests" (BGHH, p. 13354). Here BGHH position is inconsistent with much of the intelligence literature that does not clearly distinguish between IQ and achievement tests (e.g., Frey & Detterman, 2004), and by and large suggests that intelligence is more important than personality in predicting grades (e.g., Demetriou, Kazi, Spanoudis, & Makris, 2019; Poropat, 2009; Roth et al., 2015).

In sum, the purpose of the current paper is to re-examine BGHH conclusion that personality is more important than intelligence in predicting important life outcomes. We examine this conclusion in six large databases, including two that played a major role in BGHH work, focusing on educational and occupational success, relying on the big five personality dimensions as measures of personality.

## 2. Method

### 2.1. Data

Our analyses are based on the following six databases: The 1979 cohort of the National Longitudinal Study of Youth (NLSY79); the 1997 cohort of the National Longitudinal Study of Youth (NLSY97); the National Longitudinal Study of Adolescent to Adult Health (ADD Health); the National Survey of Midlife Development in the United States (MIDUS); The Wisconsin Longitudinal Study (WLS); and the Program for the International Assessment of Adult Competencies (PIAAC). Below we provide brief descriptions of the databases. The measures of each of the databases are summarized in Table 1 and the timing of the measurements and the average age of the participants at the time of the measurement are summarized in Table 2.

**The NLSY79**. A nationally representative American longitudinal survey sponsored by the Bureau of Labor Statistics of the U.S. The first interviews occurred in 1979 when participants were ages 14–22 and included 12,686 participants. Individuals in the NLSY79 cohort have participated in 26 follow up surveys between 1980 and 2016.

**The NLSY97.** A nationally representative American longitudinal survey that includes 8984 participants. Respondents were aged 12–17 when first interviewed in 1997. This ongoing cohort has been surveyed 18 times from 1998 to date.

**The ADD Health**. A nationally representative American survey that followed of 20,745 U.S. adolescents aged 12–19 who were attending middle or high schools during the 1994–1995 academic year, the first year the study begun. The data were collected in four waves: 1994–1995 (Wave I), 1996 (Wave II), 2001–2002 (Wave III) and 2007–2008 (Wave IV).

**The MIDUS**. A large, U.S. nationally representative sample of 7108 American adults aged 24–74 years old during the first wave in 1995–1996. The data was collected in three waves: 1995–1996 (MIDUS1), 2004–2006 (MIDUS2) and 2013 (MIDUS3).

**The WLS**. Contains information regarding 10,317 individuals aged 17–20 during the first year the study begun in 1957, who constituted approximately one-third of all seniors in Wisconsin high schools. The WLS data was collected in a series of surveys beginning in 1957, and continuing in 1964, 1975, 1992, 2004, and 2011.

**The PIAAC**. A large-scale study of the Organization for Economic Cooperation and Development (OECD) to assess and monitor key adult competencies. For the present research, we analyzed data from the original PIAAC 2012 which included 5465 participants, and the German follow up longitudinal study from 2014 (PIAAC-L) which included 3758 out of the original PIAAC sample, since the latter included supplementary data of the Big-Five personality traits.[1] The subjects aged 16–65 were randomly selected from local population registers in randomly selected municipalities throughout Germany.

The sex distribution was about even in all six datasets, ranging from 49% females in NLSY97 to 54% in MIDUS. In all datasets we used a listwise deletion depending on the success criteria.

### 2.2. Measures

#### 2.2.1. Intelligence

Our measure of intelligence in the NLSY97 and NLSY79 was derived from test scores in the Armed Forces Qualifying Test (AFQT), the standard measure of intelligence used by the US army.[2] The AFQT score in the NLSY is the sum of the standardized scores of four tests: arithmetic reasoning, paragraph comprehension, word knowledge and mathematics knowledge, and is expressed as a percentile score out of the general population. The AFQT was used previously by many studies as a valid measure of intelligence (e.g., Trevor, 2001; Bowles, Gintis, & Osborne, 2001; Heckman & Rubinstein, 2001; Murray, 2002; Heckman & Carneriro, 2002; Heckman, Stixrud, & Urzua, 2006). We note that in their analysis of the NLSY79, BGHH's used a different measure of intelligence, which they constructed from data of five intelligence tests that were available for some of the participants (California Test of Mental Maturity, Lorge-Thorndike Intelligence Test, Henmon-Nelson Test of Mental Maturity, Kuhlmann-Anderson Intelligence Test, Stanford-Binet Intelligence Scale, and Wechsler Intelligence Scale for Children). We preferred relying on the AFQT because it was available for most of the participants, whereas BGHH measure was available only for 12% of them. We further discuss the use of these two measures below.

The measure of intelligence in the ADD Health was the Peabody Picture Vocabulary Test (PVT). PVT measures verbal skills and receptive vocabulary and is highly correlated with other standardized cognitive measures such as the Wechsler Adult Intelligence Scale (Bell, Lassiter, Matthews, & Hutchinson, 2001).[3]

The measure of intelligence in the MIDUS was the Brief Test of Adult Cognition by Telephone (BTACT). The test includes word list recall, delayed word list recall, counting digits backwards, categorical fluency,

[1] Programme for the International Assessment of Adult Competencies (PIAAC), Germany - Reduced Version. Data file version 2.2.0 [ZA5845]. Cologne: GESIS Data Archive. https://doi.org/10.21241/ssoar.72521

[2] For more information on the measurement of the AFQT please refer to: https://www.nlsinfo.org/content/cohorts/nlsy79/topical-guide/education/aptitude-achievement-intelligence-scores

[3] For more information about the measurement of the PVT please refer to: https://www.thearda.com/Archive/Files/Descriptions/ADDHW3PVT.asp

**Table 1**
Summary of measurements taken in each of the six surveys.

| | SEB | Intelligence | Personality | Educational attainment | GPA | Pay |
|---|---|---|---|---|---|---|
| NLSY79 | Parental income and education | AFQT | TIPI | 1–8 scale | High school GPA | Log hourly pay |
| NLSY97 | Parental income and education | AFQT | TIPI | 1–8 scale | High school GPA | Log hourly pay |
| ADD Health | Parental income and education | PPVT | mini-IPIP | 1–13 scale | n/a | Log annual income from salary |
| MIDUS | Parental socio economic index (SEI-80) | BTACT | MIDI | 1–11 scale | n/a | Log annual income on a 1–42 scale |
| WLS | Duncan SEI score for head of household (Duncan, 1961) | Henmon-Nelson | BFI-10 | Years of Education | 3 categories for High school GPA | Log hourly pay |
| PIAAC | Parental school & professional education | Adult test of numeracy and literacy | BFI-S | 1–7 scale (ISCED) | n/a | Log monthly income |

**Table 2**
Year and average age (in parenthesis) at the time of each measurement.

| Year | SEB | Intelligence | Personality | Educational attainment | GPA | Pay |
|---|---|---|---|---|---|---|
| NLSY79 | 1979 (18) | 1981[a] (20) | 2014 (53) | 2012 (51) | 1981 (20) | 2016 (55) |
| NLSY 97 | 1997 (15) | 1999 (17) | 2008 (26) | 2015 (33) | 2015 (33) | 2015 (33) |
| ADD Health | 2002 (24) | 2002 (24) | 2008 (29) | 2008 (29) | n/a | 2008 (29) |
| MIDUS | 1995 (38) | 1995 (38) | 1995 (38) | 2005[b] (48) | n/a | 2005[b] (48) |
| WLS | 1957 (18) | 1957 (18) | 1992 (53) | 1992 (53) | 1992 (53) | 1992 (53) |
| PIAAC | 2012 (40) | 2012 (40) | 2014 (42) | 2012 (40) | n/a | 2012 (40) |

[a] The AFQT, our main measure of intelligence in the NLSY79, was measured in 1981; other IQ tests were obtained from participants' school record from early childhood to the 12th grade.

[b] Since our interest is to measure educational and occupational success, we included in the MIDUS analysis only individuals below 60 years old during 2004–2006 wave - see Borghans et al., 2016 for a similar method.

and number series. While not a formal IQ test, many of the sub-tests are included in some IQ tests (see for example Tun & Lachman, 2006).[4]

The measure of intelligence in the WLS was the Henmon-Nelson Test of Mental Abilities is a 30 min' test that consists of 90 items, designed to measure verbal, spatial, and numerical knowledge and reasoning. Former research has reported strong correlations between Henmon-Nelson scores and other standardized cognitive measures, such as WAIS and AFQT (Herrnstein & Murray, 1994, p. 584).

The measure of intelligence in PIAAC was the average of literacy and numeracy test scores (see Kirsch, Yamamoto, & Garber, 2013). The PIAAC's literacy test measure the ability to understand and use information from written texts in a variety of contexts to achieve goals and develop knowledge and potential. The numeracy test measures the ability to use, apply, interpret, and communicate mathematical information and ideas. Both literacy and numeracy were assessed using a randomized and adaptive testing design where for each participant, 10 plausible values were estimated for each one of the two abilities. Results were then averaged within each domain.[5]

### 2.2.2. Personality

The measure of personality in the NLSY97 and NLSY79 was the Ten-Item Personality Inventory (TIPI, Gosling, Rentfrow, & Swann Jr, 2003),[6] a 10-item measure of the big-five dimensions of personality: extraversion, agreeableness, conscientiousness, openness and emotional-stability. The response scale ranged from disagree strongly (1) to agree strongly (7). The average reliability of the five dimensions was 0.72.

ADD Health assessed the big-five personality dimensions using the Mini-IPIP – a 20-item short form of the International Personality Item Pool (Baldasaro, Shanahan, & Bauer, 2013; Donnellan, Oswald, Baird, & Lucas, 2006). The response scale ranged from disagree strongly (1) to agree strongly (7). The average reliability of the five dimensions was 0.67.

MIDUS assessed the big-five personality traits using the Midlife Development Inventory (MIDI, Lachman & Weaver, 1997; Prenda & Lachman, 2001), a 25-item measure of the big-five personality traits.[7] Each of the five personality traits was assessed using between 4 and 7 adjectives (overall 25 items). Average reliability of the five dimensions was 0.74.

The measure of personality in the WLS was a 10-item subset of the original Big Five Inventory (BFI; John, 1990). The questionnaire consisted of two items to represent each of the five core personality dimensions, where participants indicated the extent they agree the item represent them on a 6-point scale from agree strongly (1) to disagree strongly (6). Average reliability of the five dimensions was 0.68.

The measure of personality in the PIAAC was a shortened version of the BFI, using a 15-item questionnaire developed for use in the German Socio-Economic Panel (BFI-S; Gerlitz & Schupp, 2005). The BFI-S contains an additional item per each one of the five personality dimensions on top of the BFI-10, with overall three item per dimension to be answered on a seven-point scale ranging from does not apply (1) to applies fully (7). Average reliability of the five dimensions was 0.61.

### 2.2.3. Control variables

*Sex* was coded as 0 for males and 1 for females.

*Socio-economic background (abbreviated as SEB).* For discussion of the role of SEB in occupational and educational success (see for example Sirin's meta-analysis, 2005; Strenze, 2007). The measure of SEB in the WLS was Duncan's socio-economic-index (Duncan, 1961). The measure of SEB in MIDUS was the SEI-80 socioeconomic index.[8] NLSY97,

[4] More information about the BTACT can be found at http://midus.wisc.edu/midus2/project3 and www.brandeis.edu/projects/lifespan

[5] More information about PIAAC literacy and numeracy tests can be found in https://www.oecd-ilibrary.org/education/oecd-skills-outlook-2013_9789264204256-en

[6] TIPI measure can be found here https://gosling.psy.utexas.edu/wp-content/uploads/2014/09/tipi.pdf. For more information please refer to https://gosling.psy.utexas.edu/scales-weve-developed/ten-item-personality-measure-tipi

[7] For information on MIDI see http://midus.wisc.edu/midus2/project3 and www.brandeis.edu/projects/lifespan

[8] For more information please refer to www.ssc.wisc.edu/wlsresearch/documentation/appendices/E/

NLSY79, ADD Health and PIAAC datasets did not include a measure of SEB, therefore we derived this measure from averaging the standard scores of both parents' income and educational attainment. See more information in Table 1.

*Age.* Since in MIDUS and PIAAC datasets the ages differ significantly among participants, age was added to the regression as a control variable. The other four datasets followed a cohort where participants were born around the same year, therefore age was not entered into the regression.[9]

#### 2.2.4. Success

Educational success was measured by educational attainment and by high-school GPA. Occupational success was measure by the logarithm of pay.

*Educational attainment.* Both the NLSY79 and NLSY97 include a scale of 8 items ranging from no educational degree at all (0) to professional degree (7). ADD Health and MIDUS include similar scales with 11 and 13 categories, respectively. Our measure of educational attainment in the WLS was number of years of education based on highest degree.

In PIAAC, the highest level of education was assessed in seven categories based on the International Standard Classification of Education (ISCED 1997).[10]

*High school GPA score.* High school grade point averages across all courses on a 4-point grading scale.

*Occupational success.* Following much of the applied psychology literature (see for example Judge & Hurst, 2008; Seibert, Crant, & Kraimer, 1999), we used log pay as a measure of occupational success. For NLSY97, NSLY79 and WLS we used hourly pay. Add Health and MIDUS include measurements of annual income, PIAAC includes monthly salary.

## 3. Results

### 3.1. Main analyses

Following BGHH, in our main analysis we compare the uncontrolled for $R^2$ of intelligence and personality in predicting occupational and educational success. Table 3 presents the results of this analysis. For intelligence we present the simple squared correlation between intelligence and our measures of success and for personality we present the $R^2$ of regressions in which our measures of success are regressed on the big five dimensions (see appendix A, Tables A1–A6 for the correlations of our success measures with each of the five dimensions in each of the datasets. See Table A7 for the average correlations). In addition, as a direct estimate of the relative predictive validities of intelligence and personality, for each of the outcomes we present the ratio of the $R^2$ of intelligence to the $R^2$ of personality.

It is clear from this table that the predictive validity of intelligence, both with regard to educational success and with regard to occupational success, far exceed the predictive validity of personality. For educational attainment the average $R^2$ of intelligence was 0.232 whereas for personality it was 0.053. For GPA it was 0.229 and 0.024, respectively and for pay it was 0.080 and 0.040, respectively. In relative terms, for educational attainment the predictive validity of intelligence is about 4.4 times higher than the predictive validity of personality, for GPA it is about 9.6 time higher, and for pay it is about twice as high. These findings are consistent with previous studies which demonstrated that intelligence is the most dominant predictor of academic and job performance (e.g., Hunter, 1986; Kuncel, Hezlett, & Ones, 2004; Laidra, Pullmann, & Allik, 2007; Schmidt & Hunter, 2004; Zisman & Ganzach, 2020), but not with BGHH conclusion that the predictive power of personality is higher than the predictive power of intelligence.

Finally, it is worthwhile noting that although our results show that intelligence is more important both in predicting occupational success and in predicting educational success, it is relatively more important in predicting educational success (compare the ratios in columns 3 and 6 of Table 3 to the ratios in column 9). This result is consistent with the idea that intellectual skills are more important in educational success than in occupational success, whereas inter-personal skills are more important in occupational success than in educational success.

### 3.2. Robustness checks

We conducted two robustness checks of our results. First, since the reliabilities of measures of personality are considerably lower than those of intelligence, we corrected for the reliabilities of our personality and intelligence measures. In these analyses we used a reliability of 0.92 for intelligence (e.g., the reliability of the test-retest correlation of the AFQT is 0.92 (Valentine Jr & Massey, 1976)), and a reliability of 0.72 for personality (e.g., the average reliability of the TIPI big-five is.72, Gosling et al., 2003). However, as shown in Appendix B, differences in reliabilities do not explain the large differences in $R^2$ between intelligence and personality in our data. We further discuss the role of reliability in comparing between the predictive validity of intelligence and personality in the discussion section.

In our second robustness check we added basic demographic variables, sex, age and Socio-Economic Background (SEB), as controls. All are known to have strong effects on pay, whereas the third has also a strong effect on educational success (BGHH did not control for these variables). These analyses included also reciprocal controls: They controlled for personality when estimating the predictive validity of intelligence and they controlled of intelligence when estimating the predictive validity of personality (BGHH did not control for demographic variables and did not include reciprocal controls). The summary results of these analyses are presented in Appendix C (the full regressions for each of the six datasets are presented in Appendix D and the first order correlations between the variables in the models of the datasets are presented in Tables A1–A6 of Appendix A. The average correlations are presented in Table A7). Obviously, the unique variance explained by both intelligence and personality decreased in these analyses, but it is also clear from the summary results in Appendix C that when these controls are included, the relative predictive validity of intelligence is generally even greater than the one shown in Table 3 (compare columns 3, 6 and 9 in Table 3 to the same columns in Appendix C).This is consistent with the idea that the effects of personality carry influences from the effect of intelligence (Demetriou et al., 2019).[11]

[9] Indeed, additional analyses showed that it had a non-significant effects

[10] For more information about ISCED please refer to http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf C

[11] There are two differences between Table 3 (without controls) and Appendix C (with controls) which are worthwhile noting. The first difference is associated with the only exception in Table 3 – that in WLS personality had a greater predictive validity than intelligence with regard to pay. However, this was true only when controls were not included. In Appendix C, when controls were included, intelligence showed a greater predictive validity, consistent with the rest of our results. The reason for this difference is that openness to experience has a relatively high correlation with pay in the WLS dataset ($r = 0.244$, $p < .01$), which leads to an overall high predictive validity of personality. However, this correlation is due to higher openness among males, who, by and large, enjoy higher earning, than among females (for further reading on the relationship between gender and openness see Goodwin & Gotlib, 2004). As a result, when adding sex as a control, the predictive validity of openness (and personality in general) decreases substantially.The second difference between Table 3 and appendix C has to do with a substantial decrease in the predictive validity of intelligence, but not of personality, in predicting occupational success when SEB is controlled. The reason here is that SEB is associated more strongly with intelligence than with the big five (see appendix A for details). For a review of the relationship between SEB and intelligence see Strenze, (2007).

**Table 3**
$R^2$ of intelligence and personality in predicting success – without controls.

| | Educational Success | | | | | | Occupational Success | | |
|---|---|---|---|---|---|---|---|---|---|
| | Educational Attainment | | | GPA | | | Log Pay | | |
| | Intelligence (1) | Personality (2) | $\frac{R^2 Intelligence}{R^2 Personality}$ (3) | Intelligence (4) | Personality (5) | $\frac{R^2 Intelligence}{R^2 Personality}$ (6) | Intelligence (7) | Personality (8) | $\frac{R^2 Intelligence}{R^2 Personality}$ (9) |
| NLSY 79 | 0.270*** | 0.029*** | 9.3 | 0.175*** | 0.011*** | 15.9 | 0.148*** | 0.022*** | 6.7 |
| NLSY 97 | 0.328*** | 0.038*** | 8.6 | 0.268*** | 0.020*** | 13.4 | 0.096*** | 0.021*** | 4.6 |
| ADD Health | 0.120*** | 0.064*** | 1.9 | n/a | n/a | n/a | 0.031*** | 0.025*** | 1.2 |
| MIDUS | 0.305*** | 0.061*** | 5.0 | n/a | n/a | n/a | 0.091*** | 0.049*** | 1.9 |
| WLS | 0.199*** | 0.079*** | 2.5 | 0.245*** | 0.041*** | 6.0 | 0.058*** | 0.079*** | 0.7 |
| PIAAC | 0.168*** | 0.046*** | 3.7 | n/a | n/a | n/a | 0.057*** | 0.042*** | 1.4 |

*** $p < .001$.

### 3.3. The NLSY79 and the MIDUS: A comparison between BGHH analysis and ours

Since the NLSY79 and the MIDUS were analyzed both by BGHH and by us, in this section we compare the results of these two analyses.

First, in their analysis of the NLSY79, rather than using the AFQT as a measure of intelligence, as commonly done in almost all studies that are based on this database, BGHH used a measure based on five other intelligence tests (California Test of Mental Maturity, Lorge-Thorndike Intelligence Test, Henmon-Nelson Test of Mental Maturity, Kuhlmann-Anderson Intelligence Test, Stanford-Binet Intelligence Scale, and Wechsler Intelligence Scale for Children), a measure that was available only for 12% of the participants in the NLSY79 (as opposed to 94% of the participants who took the AFQT). This approach is based on BGHH view that the AFQT is an "achievement" test and the other five tests are intelligence tests. But this narrow view of intelligence is not the standard view in most studies of the relationship between intelligence and success, which view achievement tests as valid measures of intelligence (e.g. Frey & Detterman, 2004). In any case, in Appendix E we analyze the NLSY79 using BGHH's measure of intelligence, obtaining similar results to those we found for the AFQT. These results are also in line with BGHH's results who report that in the NLSY79 the predictive power of intelligence is higher than personality.

Second, BGHH results regarding pay in the MIDUS dataset are quite different from ours. While our results indicate that intelligence has a greater predictive validity than personality ($R^2$ of 0.091 and 0.049 for intelligence and personality respectively), BGHH results show a greater predictive validity for personality ($R^2$ of 0.018 and 0.050 for intelligence and personality respectively). Since we performed an exact replication of BGHH, this difference could not be explained by using a different sample or different measures. Unfortunately, we could not find an explanation for this difference.[12]

## 4. Discussion

In the six datasets we analyzed, the predictive validity of intelligence with regard to educational and occupational success was far higher than the predictive validity of the big five, our measure of personality. These findings are consistent with previous research that directly compared the predictive validity of measures of intelligence to trait measures of personality such as grit (Zisman & Ganzach, 2020) and Core-Self-Evaluations (Ganzach & Pazy, 2014), and are clearly inconsistent with BGHH claim that personality is generally more predictive than intelligence for a variety of important life outcomes.

We note however that our comparison between the predictive power of intelligence and the predictive power of personality focused only on some of the outcomes BGHH examined. We did not compare the roles of intelligence and personality in predicting the other outcomes examined by BGHH and in particular, depression, physical health, mental health and life satisfaction. As we discuss above, these comparisons are difficult to make because the use of rating scales in measuring both the dependent and the independent variables. Hopefully with the increased availability of large scale real-life data, such as medical records, more opportunities for unbiased examination of the relationship between personality and health outcomes will become available.

We also note that in many respects the results of a comparison between the predictive validity of intelligence and personality is difficult to interpret because whereas intelligence is a unitary construct, personality is not. Most of the research on intelligence proposes a single underlying construct – general mental ability – that to a large extent explain all related observed measures; therefore, there is relatively little ambiguity about the conceptualization of intelligence in studying the prediction of life outcomes. On the other hand, most of the personality research, at least the research relevant to the prediction of important life outcomes, focus on a narrow, single traits, each describing a specific facet of personality (e.g., grit, see Duckworth et al., 2007; planfulness, see Ludwig, Srivastava, & Berkman, 2019). This method also characterizes most of BGHH analyses, although in some of them they do attempt to overcome this narrow single-trait treatment of personality by using a combination of traits. For example, in their analysis of the British Cohort Study they used a combination of measures of self-esteem, locus of control, disorganized activity, anti- social behavior, neuroticism, and introversion; and in their analysis of the NLSY79 they used a combination of self-esteem and locus of control. In the current paper we chose to focus on operationalizing personality in terms of the big-five personality dimensions, which, although being based on the combination of five narrow traits, is thought to provide a full description of personality. Yet, our results reveal that even with this comprehensive operationalization of personality, the predictive validity of intelligence was substantially higher than the predictive validity of personality.

Aside of issues regarding the operationalizations of personality and intelligence, there are issues associated with the construct validities and reliabilities of these operationalizations. First, since the predictive validity of a measure depends on its reliability, the low predictive validity of the big five may not necessarily be associated with personality being unimportant for educational and occupational success, but can also be associated with unreliable measurement of the big-five. In our main analyses we disregarded issues of reliability and adhered to BGHH approach, routed in the tradition of economic research that focus on the

[12] In an attempt to understand the difference between the results,we contacted the first author of BGHH paper (October 28th, 2020; December 30th, 2020), but received no response. We also note that our replication of BGHH reached a slightly higher number of observations ($n = 1712$ vs. 1651 of BGHH), since our analysis includes 41 observations of individuals earning $200,000 or more which BGHH omitted. However, these additional observations do not explain the difference in the results (the predictive validity of intelligence remains 1.8 times higher than personality even when excluding these 41 observations).

relationships between measures rather than the relationships between constructs. This disregard is problematic only if one is interested in theoretical questions regarding concepts, but not in practical questions regarding predictions. Furthermore, as our results indicate (appendix B), the large advantage of intelligence over the big-five personality measures does not change much when we correct for the reliability of our measures. Thus, we do not view differences between the reliability of our measures as a serious threat to the soundness of our conclusions.

The construct validity of our measures may be a more serious concern in interpreting the current results as suggesting that intelligence is more important to educational and occupational success than personality. In particular, as discussed above, whereas intelligence is a narrow construct, personality is a multi-faceted construct, and therefore measures of intelligence have a better construct validity than measures of personality. From a different perspective, whereas intelligence is an individual characteristic that is generally relevant to success in tasks that involve dealing with cognitive complexity (Gottfredson, 1997), and therefore highly relevant to educational and occupational success, personality as conceptualized by the big-five personality dimensions, is less relevant to education and occupational success, since the effect of personality on behavior in general (Mischel, 1977), and on behavior that leads to success in particular (Shaffer & Postlethwaite, 2012), is to a large extent context dependent.

There are other factors that may affect the predictive validity of measures of intelligence and personality. The predictive power of intelligence versus personality in occupational success may depend on the specific type of job. Thus intelligence may be a better predictor of success complex occupation that involve variety of tasks than in simple repetitive jobs (Hunter & Hunter, 1984) while personality may be a better predictor of jobs that require endurance (Duckworth et al., 2019). The age at which the measurement of success was taken may be important because intelligence is more weakly correlated with occupational success early than later in life as a result of people gradually gravitating toward jobs that are commensurate with their abilities (Wilk, Desmarais, & Sackett, 1995). The period in which the data regarding success were collected may be important as well, since in occupational success the importance of intelligence versus other factors may have increased over time because the increased importance of complex jobs in more modern societies (Herrnstein & Murray, 1994). Yet, as Table 2 shows, our datasets consist of representative sample that spans considerable range of ages and periods, thus allowing for some confidence in their generalizability.

We conclude by suggesting that although the analyses reported in this paper clearly suggest that educational and occupational success is better predicted by measures of intelligence than by measures of the big five personality dimensions, they do not necessarily imply that intelligence is more important for success than personality. They may simply imply that it is difficult to assess those aspects of one's personality that lead to educational and occupational success based on a trait approach to personality because self-characterizations used by personality tests are not be as accurate measures of "true" personality as scores in intelligence test are of "true" intelligence, or because the accuracy of self-characterizations depends on the accuracy of self-monitoring and self-representation whereas the accuracy of intelligence tests does not depend on these factors.

In this respect, other approaches for personality assessment may be more successful in predicting success. In particular, given the pattern of relatively higher importance of personality in predicting occupational success than in predicting educational success which was apparent in our results, we think that the trait approach to personality assessment may under-estimate the predictive power of personality. This idea is consistent with findings suggesting that non-cognitive work-related assessment such as interviews (e.g., Schmidt & Hunter, 1998), peer evaluations (Oh & Berry, 2009), or the assessment of "work personality" (Heller, Ferris, Brown, & Watson, 2009), are good predictors of work success, better than trait based personality characteristics. However, these assessments could hardly be viewed as assessing personality characteristics in that they are not based on any theory-based representation of personality. It remains to be seen whether improved theory-based representation of personality will be able to provide a better predictive power of occupational success.

## Appendix A. Descriptive Statistics and Inter-Correlations

### A.1. NLSY79

| | | N | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Sex | 12,686 | 0.495 | 0.500 | – | | | | | | | | | |
| (2) | SEB | 12,394 | −0.308 | 0.983 | −0.016 | – | | | | | | | | |
| (3) | Intelligence | 11,882 | 42.51 | 28.739 | −0.007 | 0.502** | – | | | | | | | |
| (4) | Conscientiousness | 6960 | 4.524 | 1.298 | 0.053** | 0.134** | 0.148** | – | | | | | | |
| (5) | Extraversion | 6778 | 4.923 | 1.236 | 0.106** | 0.072** | 0.081** | 0.254** | – | | | | | |
| (6) | Agreeableness | 6972 | 2.616 | 1.261 | 0.019 | −0.067** | −0.143** | −0.187** | −0.334** | – | | | | |
| (7) | Emotional Stability | 6965 | 2.485 | 1.295 | −0.125** | −0.021 | −0.061** | −0.109** | −0.288** | 0.391** | – | | | |
| (8) | Openness | 6927 | 5.05 | 1.267 | −0.028* | 0.039** | 0.063** | 0.172** | 0.262** | −0.384** | −0.346** | – | | |
| (9) | Educational Attainment | 7218 | 1.801 | 1.726 | 0.044** | 0.360** | 0.519** | 0.132** | 0.090** | −0.130** | −0.082** | 0.077** | – | |
| (10) | GPA | 8326 | 2.238 | 0.922 | 0.108** | 0.213** | 0.418** | 0.031* | 0.042** | −0.099** | −0.065** | 0.037** | 0.329** | – |
| (11) | Log Hourly Pay | 5129 | 7.695 | 0.871 | −0.179** | 0.274** | 0.384** | 0.129** | 0.018 | −0.083** | −0.015 | 0.048** | 0.316** | 0.177** |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

### A.2. NLSY97

| | | N | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Sex | 6748 | 0.487 | 0.500 | – | | | | | | | | | |
| (2) | SEB | 4588 | 0.149 | 1.013 | −0.013 | – | | | | | | | | |
| (3) | Intelligence | 5428 | 50.23 | 28.954 | 0.032* | 0.450** | – | | | | | | | |
| (4) | Conscientiousness | 5521 | 5.661 | 1.113 | 0.064** | 0.014 | −0.038* | – | | | | | | |
| (5) | Extraversion | 5477 | 4.718 | 1.346 | 0.104** | 0.080** | 0.066** | 0.108** | – | | | | | |
| (6) | Agreeableness | 5358 | 3.014 | 1.104 | 0.224** | 0.064** | 0.079** | 0.140** | 0.098** | – | | | | |

(continued on next page)

(*continued*)

| | | N | Mean | SD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (7) | Emotional Stability | 5517 | 4.961 | 1.336 | −0.145** | 0.102** | 0.169** | 0.258** | 0.144** | 0.280** | – | | | |
| (8) | Openness | 5481 | 5.702 | 1.231 | −0.015 | 0.064** | 0.057** | 0.152** | 0.243** | 0.186** | 0.181** | – | | |
| (9) | Educational Attainment | 5253 | 2.592 | 1.496 | 0.087** | 0.487** | 0.573** | 0.104** | 0.075** | 0.108** | 0.166** | 0.057** | – | |
| (10) | GPA | 4768 | 278.5 | 76.158 | 0.151** | 0.328** | 0.518** | 0.074** | 0.053** | 0.094** | 0.109** | 0.005 | 0.514** | – |
| (11) | Log Hourly Pay | 4440 | 2.911 | 0.659 | −0.114** | 0.304** | 0.311** | 0.082** | 0.049** | −0.006 | 0.120** | 0.015 | 0.406** | 0.217** |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

### *A.3. ADD Health*

| | | N | Mean | STD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Sex | 5114 | 0.54 | 0.498 | – | | | | | | | | |
| (2) | SEB | 3553 | 0.04 | 1.000 | −0.017 | – | | | | | | | |
| (3) | Intelligence | 4063 | 100.40 | 14.759 | −0.047** | 0.272** | – | | | | | | |
| (4) | Conscientiousness | 5107 | 3.66 | 0.685 | 0.106** | −0.008 | −0.041** | – | | | | | |
| (5) | Extraversion | 5108 | 3.32 | 0.770 | 0.046** | 0.056** | 0.011 | 0.064** | – | | | | |
| (6) | Agreeableness | 5108 | 3.84 | 0.594 | 0.276** | 0.098** | 0.152** | 0.169** | 0.276** | – | | | |
| (7) | Emotional Stability | 5107 | 3.21 | 0.661 | −0.217** | 0.056** | 0.124** | 0.123** | 0.089** | 0.054** | – | | |
| (8) | Openness | 5105 | 3.66 | 0.616 | −0.113** | 0.134** | 0.259** | 0.029* | 0.223** | 0.276** | 0.155** | – | |
| (9) | Educational Attainment | 5111 | 5.73 | 2.579 | 0.105** | 0.280** | 0.271** | 0.064** | 0.055** | 0.189** | 0.132** | 0.176** | – |
| (10) | Log Income | 4486 | 10.15 | 1.024 | −0.153** | 0.158** | 0.175** | 0.039** | 0.064** | 0.012 | 0.143** | 0.058** | 0.230** |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

### *A.4. MIDUS*

| | | N | Mean | STD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Age | 2949 | 48.04 | 7.279 | – | | | | | | | | | |
| (2) | Sex | 2949 | 0.54 | 0.498 | −0.030 | – | | | | | | | | |
| (3) | SEB | 2780 | 37.06 | 13.012 | −0.087** | −0.033 | – | | | | | | | |
| (4) | Intelligence | 2559 | −2.49 | 0.597 | 0.068** | −0.051* | 0.280** | – | | | | | | |
| (5) | Conscientiousness | 2736 | 3.45 | 0.440 | 0.051** | 0.121** | 0.015 | 0.081** | – | | | | | |
| (6) | Extraversion | 2738 | 3.19 | 0.559 | −0.051** | 0.044* | −0.013 | 0.007 | 0.242** | – | | | | |
| (7) | Agreeableness | 2735 | 3.46 | 0.492 | 0.025 | 0.255** | −0.075** | −0.052* | 0.266** | 0.502** | – | | | |
| (8) | Emotional Stability | 2735 | 2.32 | 0.669 | −0.071** | 0.131** | −0.056** | −0.067** | −0.174** | −0.155** | −0.026 | – | | |
| (9) | Openness | 2735 | 3.02 | 0.518 | −0.025 | −0.111** | 0.075** | 0.135** | 0.248** | 0.514** | 0.342** | −0.182** | – | |
| (10) | Educational Attainment | 2946 | 7.38 | 2.415 | −0.024 | −0.071** | 0.363** | 0.552** | 0.090** | −0.006 | −0.052** | −0.101** | 0.179** | – |
| (11) | Log Income | 1894 | 10.48 | 0.961 | −0.000 | −0.316** | 0.176** | 0.301** | 0.092** | −0.000 | −0.130** | −0.081** | 0.086** | 0.261** |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

### *A.5. WLS*

| | | N | Mean | STD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Sex | 10,317 | 0.516 | 0.500 | – | | | | | | | | | |
| (2) | SEB | 9375 | 344.9 | 232.335 | −0.007 | – | | | | | | | | |
| (3) | Intelligence | 10,317 | 100.5 | 14.916 | −0.012 | 0.240** | – | | | | | | | |
| (4) | Conscientiousness | 8341 | 9.599 | 2.293 | 0.029** | −0.035** | 0.001 | – | | | | | | |
| (5) | Extraversion | 8207 | 8.498 | 2.662 | 0.099** | 0.072** | −0.011 | 0.055** | – | | | | | |
| (6) | Agreeableness | 8319 | 9.885 | 2.068 | 0.140** | −0.017 | −0.059** | 0.176** | 0.064** | – | | | | |
| (7) | Emotional Stability | 8233 | 7.651 | 2.954 | −0.121** | 0.032** | 0.082** | 0.157** | 0.105** | 0.218** | – | | | |
| (8) | Openness | 8289 | 9.225 | 2.538 | −0.182** | 0.122** | 0.245** | 0.111** | 0.184** | 0.002 | 0.179** | – | | |
| (9) | Educational Attainment | 8492 | 13.61 | 2.261 | −0.159** | 0.309** | 0.446** | −0.001 | 0.010 | −0.043** | 0.082** | 0.271** | – | |
| (10) | GPA | 5072 | 2.29 | 0.655 | 0.161** | 0.122** | 0.495** | 0.109** | 0.040** | 0.023 | 0.077** | 0.171** | 0.373** | – |
| (11) | Log Hourly Pay | 7559 | 9.436 | 0.759 | −0.427** | 0.136** | 0.241** | 0.030** | −0.007 | −0.076** | 0.109** | 0.244** | 0.366** | 0.122** |

** Correlation is significant at the 0.01 level (2-tailed).

### A.6. PIAAC

| | | N | Mean | STD | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Age | 5465 | 39.77 | 14.005 | – | | | | | | | | | |
| (2) | Sex | 5465 | 0.51 | 0.500 | 0.021 | – | | | | | | | | |
| (3) | SEB | 5139 | −0.00 | 0.835 | −0.308** | 0.022 | – | | | | | | | |
| (4) | Intelligence | 5379 | 274.57 | 45.731 | −0.181** | −0.104** | 0.326** | – | | | | | | |
| (5) | Conscientiousness | 3758 | 5.78 | 0.936 | 0.169** | 0.114** | −0.117** | −0.093** | – | | | | | |
| (6) | Extraversion | 3757 | 5.03 | 1.145 | −0.112** | 0.083** | 0.025 | −0.057** | 0.167** | – | | | | |
| (7) | Agreeableness | 3757 | 5.44 | 0.951 | −0.009 | 0.129** | 0.007 | −0.030 | 0.218** | 0.040* | – | | | |
| (8) | Emotional Stability | 3757 | 4.16 | 1.264 | 0.041* | −0.210** | 0.020 | 0.135** | 0.044** | 0.141** | 0.112** | – | | |
| (9) | Openness | 3757 | 5.03 | 1.034 | −0.019 | 0.068** | 0.125** | 0.114** | 0.161** | 0.323** | 0.110** | 0.016 | – | |
| (10) | Educational Attainment | 5379 | 7.72 | 3.622 | 0.272** | −0.008 | 0.197** | 0.409** | 0.055** | −0.059** | −0.025 | 0.099** | 0.127** | – |
| (11) | Log Income | 3746 | 7.46 | 0.962 | 0.269** | −0.263** | −0.025 | 0.240** | 0.042* | −0.059** | −0.089** | 0.136** | −0.011 | 0.410** |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

### A.7. Average Correlations

| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Sex | – | | | | | | | | | |
| (2) | SEB | −0.011 | – | | | | | | | | |
| (3) | Intelligence | −0.032 | 0.345 | – | | | | | | | |
| (4) | Conscientiousness | 0.081 | 0.001 | 0.010 | – | | | | | | |
| (5) | Extraversion | 0.080 | 0.049 | 0.016 | 0.148 | – | | | | | |
| (6) | Agreeableness | 0.174 | 0.002 | −0.009 | 0.130 | 0.108 | – | | | | |
| (7) | Emotional Stability | −0.115 | 0.022 | 0.064 | 0.050 | 0.006 | 0.172 | – | | | |
| (8) | Openness | −0.064 | 0.093 | 0.146 | 0.146 | 0.292 | 0.089 | 0.001 | – | | |
| (9) | Educational Attainment | 0.000 | 0.333 | 0.462 | 0.074 | 0.028 | 0.008 | 0.049 | 0.148 | – | |
| (10) | GPA | 0.140 | 0.221 | 0.477 | 0.071 | 0.045 | 0.006 | 0.040 | 0.071 | 0.405 | – |
| (11) | Log Pay | −0.242 | 0.171 | 0.275 | 0.069 | 0.011 | −0.062 | 0.069 | 0.073 | 0.363 | 0.236 |

## Appendix B. $R^2$ of Intelligence and Personality in Predicting Success – Corrected for Reliability

| | Educational Success | | | | | | Occupational Success | | |
|---|---|---|---|---|---|---|---|---|---|
| | Educational Attainment | | | GPA | | | Log Pay | | |
| | Intelligence (1) | Personality (2) | $\frac{R^2 Intelligence}{R^2 Personality}$ (3) | Intelligence (4) | Personality (5) | $\frac{R^2 Intelligence}{R^2 Personality}$ (6) | Intelligence (7) | Personality (8) | $\frac{R^2 Intelligence}{R^2 Personality}$ (9) |
| NLSY 79 | 0.293*** | 0.041*** | 7.1 | 0.190*** | 0.015*** | 12.1 | 0.160*** | 0.031*** | 5.1 |
| NLSY 97 | 0.356*** | 0.054*** | 6.6 | 0.291*** | 0.028*** | 10.2 | 0.104*** | 0.030*** | 3.5 |
| ADD Health | 0.130*** | 0.091*** | 1.4 | n/a | n/a | n/a | 0.033*** | 0.035*** | 0.9 |
| MIDUS | 0.331*** | 0.087*** | 3.8 | n/a | n/a | n/a | 0.098*** | 0.070*** | 1.4 |
| WLS | 0.216*** | 0.112*** | 1.9 | 0.266*** | 0.058*** | 4.5 | 0.063*** | 0.113*** | 0.6 |
| PIAAC | 0.182*** | 0.065*** | 2.8 | n/a | n/a | n/a | 0.062*** | 0.060*** | 1.0 |

Note: correction for reliability done with the following conservative assumptions:
$r_{Personality,\ personality} = 0.70$ (see for example TIPI big-five measure; Gosling, Rentfrow, & Swann, 2003).
$r_{Intelligence,\ Intelligence} = 0.92$ (based on AFQT; Valentine & Massey, 1976).
For the correlation between the dependent variance we assume $r = 1.00$.
*** $p < .001$.

## Appendix C. $\Delta R^2$ of intelligence and personality in predicting success – with controls

| | Educational Success | | | | | | Occupational Success | | |
|---|---|---|---|---|---|---|---|---|---|
| | Educational Attainment | | | GPA | | | Log Pay | | |
| | Intelligence (1) | Personality (2) | $\frac{R^2 Intelligence}{R^2 Personality}$ (3) | Intelligence (4) | Personality (5) | $\frac{R^2 Intelligence}{R^2 Personality}$ (6) | Intelligence (7) | Personality (8) | $\frac{R^2 Intelligence}{R^2 Personality}$ (9) |
| NLSY 79 | 0.145*** | 0.012* | 12.1 | 0.171*** | 0.019** | 9.0 | 0.071*** | 0.025** | 2.8 |
| NLSY 97 | 0.143*** | 0.016*** | 8.9 | 0.184*** | 0.013*** | 14.2 | 0.044*** | 0.016*** | 2.8 |
| ADD Health | 0.054*** | 0.043*** | 1.3 | n/a | n/a | n/a | 0.018*** | 0.015*** | 1.2 |
| MIDUS | 0.194*** | 0.014*** | 13.9 | n/a | n/a | n/a | 0.054*** | 0.018*** | 3.0 |
| WLS | 0.113*** | 0.016*** | 7.1 | 0.199*** | 0.020*** | 10.0 | 0.031*** | 0.017*** | 1.8 |
| PIAAC | 0.147*** | 0.008*** | 18.4 | n/a | n/a | n/a | 0.068*** | 0.014*** | 4.9 |

Note: for each dataset we ran three hierarchical regressions separately, one for each dependent variable – educational attainment, GPA and pay. In the first step of each regression we inserted basic controls – sex, age and SEB (social economic background). In order to obtain the incremental explained variance ($\Delta R^2$) of intelligence we inserted first the Big-Five variables in next step (Model 2.1), prior adding intelligence in the final step (Model 2.2). To obtain the incremental explained variance of personality we inserted intelligence prior (Model 3.1) adding the Big-Five in the final step (Model 3.2).

* $p < .05$.

** $p < .01$.

*** $p < .001$.

## Appendix D. Regression Analysis Predicting Educational and Occupational Success

### D.1. NLSY79

| | Educational Attainment | | GPA | | Log Pay | |
|---|---|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Model 1 | | 0.129*** | | 0.058*** | | 0.102*** |
| Sex | 0.048 | | 0.120 | | −0.175 | |
| SEB | 0.358 | | 0.213 | | 0.261 | |
| Model 2.1 | | 0.016*** | | 0.011*** | | 0.015*** |
| Sex | 0.042 | | 0.123 | | −0.181 | |
| SEB | 0.344 | | 0.212 | | 0.248 | |
| Conscientiousness | 0.051 | | −0.028 | | 0.106 | |
| Extraversion | 0.011 | | −0.013 | | −0.022 | |
| Agreeableness | −0.081 | | −0.104 | | −0.051 | |
| Emotional stability | −0.029 | | −0.011 | | −0.017 | |
| Openness | 0.006 | | 0.001 | | −0.002 | |
| Model 2.2 | | 0.145*** | | 0.171*** | | 0.071*** |
| Sex | 0.051 | | 0.133 | | −0.173 | |
| SEB | 0.117 | | −0.018 | | 0.094 | |
| Conscientiousness | 0.025 | | −0.051 | | 0.089 | |
| Extraversion | 0.008 | | −0.012 | | −0.020 | |
| Agreeableness | −0.038 | | −0.053 | | −0.023 | |
| Emotional stability | −0.026 | | −0.016 | | −0.027 | |
| Openness | 0.010 | | 0.007 | | 0.002 | |
| Intelligence | 0.450 | | 0.479 | | 0.311 | |
| Model 3.1 | | 0.155*** | | 0.176*** | | 0.076*** |
| Sex | 0.056 | | 0.129 | | −0.165 | |
| SEB | 0.118 | | −0.024 | | 0.099 | |
| Intelligence | 0.462 | | 0.482 | | 0.320 | |
| Model 3.2 | | 0.005*** | | 0.005*** | | 0.010*** |
| Sex | 0.051 | | 0.133 | | −0.173 | |
| SEB | 0.117 | | −0.018 | | 0.094 | |
| Intelligence | 0.450 | | 0.479 | | 0.311 | |
| Conscientiousness | 0.025 | | −0.051 | | 0.089 | |
| Extraversion | 0.008 | | −0.012 | | −0.020 | |
| Agreeableness | −0.038 | | −0.053 | | −0.023 | |
| Emotional stability | −0.026 | | −0.016 | | −0.027 | |
| Openness | 0.010 | | 0.007 | | 0.002 | |
| n | | 5995 | | 4731 | | 4467 |

Note: $\Delta R^2$ is in comparison to previous model. For example, Model 2.1 shows an incremental $\Delta R^2$ of 0.016 over Model 1 when adding the Big-Five on top of sex and SEB; Model 2.2 shows an incremental $\Delta R^2$ of 0.145 when adding intelligence on top of sex, SEB and the Big-Five.

*** $p < .001$.

### D.2. NLSY97

| | Educational Attainment | | GPA | | Log Pay | |
|---|---|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Model 1 | | 0.233*** | | 0.129*** | | 0.104*** |
| Sex | 0.091 | | 0.150 | | −0.109 | |
| SEB | 0.476 | | 0.327 | | 0.304 | |
| Model 2.1 | | 0.021*** | | 0.013*** | | 0.014*** |
| Sex | 0.100 | | 0.157 | | −0.107 | |
| SEB | 0.467 | | 0.323 | | 0.304 | |

(continued on next page)

(*continued*)

| | Educational Attainment | | GPA | | Log Pay | |
|---|---|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Conscientiousness | 0.072 | | 0.058 | | 0.098 | |
| Extraversion | −0.020 | | −0.011 | | 0.008 | |
| Agreeableness | 0.012 | | 0.005 | | −0.022 | |
| Emotional stability | 0.107 | | 0.084 | | 0.051 | |
| Openness | −0.001 | | −0.045 | | −0.032 | |
| Model 2.2 | | 0.143*** | | 0.184*** | | 0.044*** |
| Sex | 0.084 | | 0.135 | | −0.119 | |
| SEB | 0.285 | | 0.130 | | 0.205 | |
| Conscientiousness | 0.105 | | 0.098 | | 0.119 | |
| Extraversion | −0.017 | | 0.005 | | 0.014 | |
| Agreeableness | 0.007 | | 0.002 | | −0.025 | |
| Emotional stability | 0.047 | | 0.021 | | 0.019 | |
| Openness | −0.007 | | −0.061 | | −0.037 | |
| Intelligence | 0.427 | | 0.477 | | 0.236 | |
| Model 3.1 | | 0.148*** | | 0.184*** | | 0.042*** |
| Sex | 0.084 | | 0.141 | | −0.115 | |
| SEB | 0.287 | | 0.130 | | 0.205 | |
| Intelligence | 0.429 | | 0.472 | | 0.228 | |
| Model 3.2 | | 0.016*** | | 0.013*** | | 0.016*** |
| Sex | 0.084 | | 0.135 | | −0.119 | |
| SEB | 0.285 | | 0.130 | | 0.205 | |
| Intelligence | 0.427 | | 0.477 | | 0.236 | |
| Conscientiousness | 0.105 | | 0.098 | | 0.119 | |
| Extraversion | −0.017 | | 0.005 | | 0.014 | |
| Agreeableness | 0.007 | | 0.002 | | −0.025 | |
| Emotional stability | 0.047 | | 0.021 | | 0.019 | |
| Openness | −0.007 | | −0.061 | | −0.037 | |
| n | | 2962 | | 2518 | | 2536 |

*** $p < .001$;

### D.3. ADD Health

| | Educational Attainment | | Log Pay | |
|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Model 1 | | 0.101*** | | 0.049*** |
| Sex | 0.152 | | −0.155 | |
| SEB | 0.283 | | 0.154 | |
| Model 2.1 | | 0.070*** | | 0.015*** |
| Sex | 0.168 | | −0.152 | |
| SEB | 0.246 | | 0.147 | |
| Conscientiousness | 0.014 | | 0.041 | |
| Extraversion | −0.030 | | 0.048 | |
| Agreeableness | 0.125 | | 0.028 | |
| Emotional stability | 0.153 | | 0.090 | |
| Openness | 0.133 | | −0.022 | |
| Model 2.2 | | 0.054*** | | 0.018*** |
| Sex | 0.165 | | −0.152 | |
| SEB | 0.187 | | 0.114 | |
| Conscientiousness | 0.030 | | 0.050 | |
| Extraversion | −0.011 | | 0.059 | |
| Agreeableness | 0.106 | | 0.017 | |
| Emotional stability | 0.132 | | 0.078 | |
| Openness | 0.079 | | −0.054 | |
| Intelligence | 0.250 | | 0.144 | |
| Model 3.1 | | 0.081*** | | 0.018*** |
| Sex | 0.159 | | −0.151 | |
| SEB | 0.202 | | 0.117 | |
| Intelligence | 0.296 | | 0.139 | |
| Model 3.2 | | 0.043*** | | 0.015*** |

(*continued on next page*)

(*continued*)

| | Educational Attainment | | Log Pay | |
|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Sex | 0.165 | | −0.152 | |
| SEB | 0.187 | | 0.114 | |
| Intelligence | 0.250 | | 0.144 | |
| Conscientiousness | 0.030 | | 0.050 | |
| Extraversion | −0.011 | | 0.059 | |
| Agreeableness | 0.106 | | 0.017 | |
| Emotional stability | 0.132 | | 0.078 | |
| Openness | 0.079 | | −0.054 | |
| n | | 3553 | | 3553 |

*** $p < .001$;

### D.4. MIDUS

| | Educational Attainment | | Log Pay | |
|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Model 1 | | 0.129*** | | 0.122*** |
| Age | 0.012 | | −0.006 | |
| Sex | −0.038 | | −0.292 | |
| SEB | 0.356 | | 0.174 | |
| Model 2.1 | | | | |
| | | 0.036*** | | 0.024*** |
| Age | 0.005 | | −0.016 | |
| Sex | −0.002 | | −0.283 | |
| SEB | 0.332 | | 0.161 | |
| Conscientiousness | 0.066 | | 0.130 | |
| Extraversion | −0.083 | | 0.025 | |
| Agreeableness | −0.067 | | −0.088 | |
| Emotional stability | −0.034 | | −0.030 | |
| Openness | 0.192 | | 0.043 | |
| Model 2.2 | | 0.194*** | | 0.054*** |
| Age | −0.028 | | −0.032 | |
| Sex | 0.001 | | −0.285 | |
| SEB | 0.209 | | 0.093 | |
| Conscientiousness | 0.037 | | 0.121 | |
| Extraversion | −0.071 | | 0.034 | |
| Agreeableness | −0.027 | | −0.074 | |
| Emotional stability | −0.026 | | −0.019 | |
| Openness | 0.122 | | 0.008 | |
| Intelligence | 0.467 | | 0.247 | |
| Model 3.1 | | 0.216*** | | 0.061*** |
| Age | −0.023 | | −0.024 | |
| Sex | −0.020 | | −0.286 | |
| SEB | 0.218 | | 0.098 | |
| Intelligence | 0.486 | | 0.259 | |
| Model 3.2 | | 0.014*** | | 0.018*** |
| Age | −0.028 | | −0.032 | |
| Sex | 0.001 | | −0.285 | |
| SEB | 0.209 | | 0.093 | |
| Intelligence | 0.467 | | 0.247 | |
| Conscientiousness | 0.037 | | 0.121 | |
| Extraversion | −0.071 | | 0.034 | |
| Agreeableness | −0.027 | | −0.074 | |
| Emotional stability | −0.026 | | −0.019 | |
| Openness | 0.122 | | 0.008 | |
| n | | 2240 | | 1577 |

*** $p < .001$;

### D.5. WLS

| | Educational Attainment | | GPA | | Log Pay | |
|---|---|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Model 1 | | 0.122*** | | 0.040*** | | 0.203*** |
| Sex | −0.163 | | 0.164 | | −0.428 | |
| SEB | 0.309 | | 0.115 | | 0.144 | |
| Model 2.1 | | 0.045*** | | 0.049*** | | 0.031*** |
| Sex | −0.113 | | 0.206 | | −0.394 | |
| SEB | 0.283 | | 0.094 | | 0.124 | |
| Conscientiousness | −0.010 | | 0.087 | | 0.033 | |
| Extraversion | −0.041 | | −0.031 | | −0.007 | |
| Agreeableness | −0.018 | | −0.028 | | −0.034 | |
| Emotional stability | 0.030 | | 0.061 | | 0.034 | |
| Openness | 0.217 | | 0.181 | | 0.165 | |
| Model 2.2 | | 0.113*** | | 0.199*** | | 0.031*** |
| Sex | −0.133 | | 0.179 | | −0.406 | |
| SEB | 0.207 | | −0.003 | | 0.085 | |
| Conscientiousness | −0.005 | | 0.099 | | 0.038 | |
| Extraversion | −0.013 | | 0.009 | | 0.008 | |
| Agreeableness | 0.006 | | 0.012 | | −0.021 | |
| Emotional stability | 0.006 | | 0.027 | | 0.023 | |
| Openness | 0.133 | | 0.076 | | 0.120 | |
| Intelligence | 0.358 | | 0.473 | | 0.188 | |
| Model 3.1 | | 0.142*** | | 0.227*** | | 0.045*** |
| Sex | −0.158 | | 0.169 | | −0.428 | |
| SEB | 0.216 | | 0.001 | | 0.093 | |
| Intelligence | 0.389 | | 0.490 | | 0.218 | |
| Model 3.2 | | 0.016*** | | 0.020*** | | 0.017*** |
| Sex | −0.133 | | 0.179 | | −0.406 | |
| SEB | 0.207 | | −0.003 | | 0.085 | |
| Intelligence | 0.358 | | 0.473 | | 0.188 | |
| Conscientiousness | −0.005 | | 0.099 | | 0.038 | |
| Extraversion | −0.013 | | 0.009 | | 0.008 | |
| Agreeableness | 0.006 | | 0.012 | | −0.021 | |
| Emotional stability | 0.006 | | 0.027 | | 0.023 | |
| Openness | 0.133 | | 0.076 | | 0.120 | |
| n | | 7646 | | 4533 | | 6811 |

*** $p < .001$;

### D.6. PIAAC

| | Educational Attainment | | Log Pay | |
|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Model 1 | | 0.165*** | | 0.131*** |
| Age | 0.377 | | 0.283 | |
| Sex | −0.028 | | −0.243 | |
| SEB | 0.303 | | 0.048 | |
| Model 2.1 | | 0.023*** | | 0.014*** |
| Age | 0.355 | | 0.268 | |
| Sex | −0.005 | | −0.219 | |
| SEB | 0.283 | | 0.049 | |
| Conscientiousness | 0.025 | | 0.060 | |
| Extraversion | −0.086 | | −0.024 | |
| Agreeableness | −0.050 | | −0.089 | |
| Emotional stability | 0.093 | | 0.090 | |
| Openness | 0.128 | | 0.011 | |
| Model 2.2 | | 0.147*** | | 0.068*** |
| Age | 0.399 | | 0.294 | |
| Sex | 0.022 | | −0.206 | |
| SEB | 0.170 | | −0.027 | |
| Conscientiousness | 0.041 | | 0.088 | |

(continued on next page)

(*continued*)

| | Educational Attainment | | Log Pay | |
|---|---|---|---|---|
| | β | $\Delta R^2$ | β | $\Delta R^2$ |
| Extraversion | −0.030 | | 0.015 | |
| Agreeableness | −0.031 | | −0.076 | |
| Emotional stability | 0.034 | | 0.056 | |
| Openness | 0.074 | | −0.018 | |
| Intelligence | 0.418 | | 0.283 | |
| Model 3.1 | | 0.162*** | | 0.069*** |
| Age | 0.413 | | 0.304 | |
| Sex | 0.019 | | −0.215 | |
| SEB | 0.175 | | −0.034 | |
| Intelligence | 0.430 | | 0.278 | |
| Model 3.2 | | 0.008*** | | 0.014*** |
| Age | 0.399 | | 0.294 | |
| Sex | 0.022 | | −0.206 | |
| SEB | 0.170 | | −0.027 | |
| Intelligence | 0.418 | | 0.283 | |
| Conscientiousness | 0.041 | | 0.088 | |
| Extraversion | −0.030 | | 0.015 | |
| Agreeableness | −0.031 | | −0.076 | |
| Emotional stability | 0.034 | | 0.056 | |
| Openness | 0.074 | | −0.018 | |
| n | | 3605 | | 2599 |

*** $p < .001$;

## Appendix E. Difference Between AFQT and Other IQ Tests in the NLSY79

In their study, BGHH differentiate between AFQT and other IQ tests when interpreting NSLY79 intelligence measures, as they claim AFQT achievement test is influenced by aspects of personality.

Therefore we further investigated the results using BGHH approach taken in NLSY79 and compared to them to the intelligence results based on AFQT. Similar to BGHH, we used z-scores constructed from several IQ tests' percentiles. The IQ tests were: California Test of Mental Maturity, Lorge-Thorndike Intelligence Test, Henmon-Nelson Test of Mental Maturity, Kuhlmann-Anderson Intelligence Test, Stanford-Binet Intelligence Scale, and Wechsler Intelligence Scale for Children.

We found a very high correlation between the AFQT and the other IQ tests ($r = 0.75$, $p < .01$). Furthermore, as shown in the table below, while the regression results are lower when using BGHH measures of IQ, they are still showing 3–11 times higher predictive validity of intelligence compared to those of personality in predicting our three success criteria (from $R^2$ of 0.022 and 0.075 for personality and intelligence respectively, to $R^2$ of 0.011 and 0.124). Therefore are still consistent with the premise of the current study.

$R^2$ of intelligence and personality in predicting success – without controls

| | Educational Attainment | GPA | Log Pay |
|---|---|---|---|
| Intelligence - AFQT | 0.270*** | 0.175*** | 0.148*** |
| Intelligence - other IQ tests | 0.146*** | 0.124*** | 0.075*** |
| Personality | 0.029*** | 0.011*** | 0.022*** |

*** $p < .001$.

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