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# How are conscientiousness and cognitive ability related to one another? A re-examination of the intelligence compensation hypothesis

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ABSTRACT

Previously, negative associations between intelligence and conscientiousness have been reported and explained in terms of an 'intelligence compensation hypothesis' (ICH) whereby higher conscientiousness develops in order to compensate for lower cognitive ability. We argue that conscientious traits, especially those related to achievement, are just as likely to be reinforced by cognitive ability. We evidence this by showing that previous negative associations may be attributable to a compensatory sample selection effect arising because of the use of research samples comprised of participants with achievement above certain thresholds. The associations between conscientiousness and ability in the samples of adolescents and their parents from the Sibling Interaction and Behaviour Study (SIBS) and Minnesota Twin Family Study (MTFS) – which were not selected in this way – were either zero or positive. Further, artificially introducing selection on achievement into these samples biased the associations in the negative direction. Together, these results are consistent with the hypothesis that the true association between these constructs may be zero or positive at the population level but that the use of selected research samples has sometimes resulted in the appearance of a negative association.



A number of studies have reported negative correlations between cognitive ability and conscientiousness-related personality traits (e.g., Furnham, Dissou, Sloan, & Chamorro-Premuzic, 2007; Furnham & Moutafi, 2012; Furnham, Moutafi, & Chamorro-Premuzic, 2005; Moutafi, Furnham, & Crump, 2003, 2006; Moutafi, Furnham, & Paltiel, 2004; Soubelet & Salthouse, 2011; Wood & Englert, 2009). Moutafi et al. (2004) proposed an intelligence compensation hypothesis (ICH) to explain this negative association, with subsequent replications often being interpreted as support for the hypothesis. The hypothesis states that individuals of lower cognitive ability become more conscientious in striving for similar levels of achievement to their peers with higher cognitive ability. Individuals higher in cognitive ability are proposed not to increase in conscientiousness because their higher cognitive ability allows them to accomplish more with the same or less effort. Thus, there is no incentive for them to invest in approaching life more conscientiously. However, the evidence for ICH is mixed. Counter to the hypothesis, positive associations between cognitive ability and conscientiousness have been observed (e.g., Baker & Bichsel, 2006; Lounsbury, Welsh, Gibson, & Sundstrom, 2005; Luciano et al., 2006) and other studies have yielded associations that were close to zero or non-significant (e.g., Bartels et al., 2012; Chamorro-Premuzic, Moutafi, & Furnham, 2005; Furnham et al., 2005). Not all studies reporting an association between cognitive ability and conscientiousness did so with the explicit aim of testing the ICH but they nonetheless contribute to the pool of evidence to be considered in evaluating the hypothesis.

A feature which partially distinguishes those studies supporting the ICH from those which do not is sample composition. The majority of studies supporting ICH have been conducted in samples which may be selected with respect to occupational or academic achievement. For example, the studies of Moutafi et al. (2004) and Furnham and Moutafi (2012) used samples of junior to middle managers attending staff development centres, whilst other studies have utilised samples of managerial grade job applicants attending assessment centres (Furnham et al., 2007; Wood & Englert, 2009). Development and assessment centres are costly (Eurich, Krause, Cigularow, & Thorton, 2009). As such, in selection situations, organisations tend only to invite small percentages of the total applicant pools to attend these centres and in training contexts, their use is more common amongst managerial and

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professional populations (Meriac, Hoffman, Woehr, & Fleisher, 2008; Pepermans, Vloeberghs, & Perkisas, 2003). Another study finding a negative IQ–conscientiousness association used a sample of undergraduate students (Furnham et al., 2005) and entry to university involves selection on prior academic achievement (e.g., Hägglund & Larsson, 2006). Similarly, a study by Soubelet and Salthouse (2011) analysed data from participants who had an average of almost 16 years of education and were approximately 2/3 to 1 standard deviation above the national norms on cognitive ability.

The selected compositions of these samples raises the possibility that the apparent negative association between intelligence and conscientiousness-related traits is due not to individual calibration of conscientiousness levels to ability level as stated in the ICH, but to compensatory *selection* into the populations from which the research samples investigating the question are taken (see Sackett, Lievens, Berry, & Landers, 2007). To enter the population of individuals employed in professional jobs or the population of individuals undertaking university level education, a certain level of achievement (educational or occupational) is necessary. Compensatory selection refers to a process whereby selection into these populations through meeting these achievement conditions can be done through combinations of ability and hard work (i.e., Conscientiousness), but hard work can compensate for relatively low ability and high ability can compensate for relatively less hard work. Thus, one could think of selection into the research sample being based on a composite of IQ and Conscientiousness. Whenever IQ is relatively low, a large enough value on the composite to reach the occupational or educational achievement level necessary for selection into the relevant population can only be achieved by having high Conscientiousness. Conversely, when Conscientiousness is relatively low, IQ must be high to obtain a high enough composite score for selection. Thus, a higher score on one trait necessarily compensates for a lower score on the other. A research sample based on a population selected in this way could yield a negative correlation between IQ and Conscientiousness even if they are un- or positively correlated in the population because it will tend to have a greater proportion of people with discrepant IQ–Conscientiousness scores than the general population.

Such compensatory selection on occupational or educational achievement would be expected to have much more powerful effects on the Conscientiousness–IQ association than would selection on either one of the traits alone (Sackett et al., 2007). This makes compensatory selection effects potentially difficult to detect because it does not necessarily require dramatic range restriction on either or both of Conscientiousness and IQ to have a substantial effect on their association.

Compensatory selection mechanisms differ from the processes implied by the ICH which suggests that there is a causal impact of IQ on conscientiousness. Compensatory *selection* invokes no such causal effect – it merely refers to sample selection that creates non-representative sub-samples of the population in whom negative associations will be observed even if this negative association is not present in the whole population.

Further, compensatory selection should be distinguished from moderation of the Conscientiousness–IQ relation by achievement. In a moderated Conscientiousness–IQ association, the association might change from positive to negative across individuals ranging from low to high achievement. However, in compensatory selection, the Conscientiousness–IQ association would track the degree of selectivity of the sample, not the level of achievement per se. Although, both compensatory selection and moderation by achievement could lead to similar patterns in real data, the latter may be more difficult to justify from a theoretical standpoint. This is because it ascribes causal precedence to achievement, which is more likely to be an outcome of conscientiousness and/or cognitive ability than a determinant.

We aimed to assess these hypotheses regarding the nature of the association between Conscientiousness and IQ. Our aim was to do so in samples for which there was little evidence of selection on educational and occupational achievement and which could, therefore, be considered free of compensatory selection. We also assessed the extent to which a negative association between Conscientiousness and IQ could be induced by artificially introducing compensatory selection on educational or occupational achievement into the sample. The purpose of this was to simulate the processes we argue may have occurred during the selection of many of the samples previously employed to assess the Conscientiousness–IQ relation. We tested this compensatory selection hypothesis against a moderated association hypothesis in order to assess whether any apparent effects of compensatory selection simply reflected moderation of the effect of IQ on conscientiousness by achievement. We hypothesised that (1) we would not find significant negative association between Conscientiousness and IQ in the whole samples and (2) that negative associations could be induced by selection on educational achievement (in an adolescent sample) and occupational achievement (in a parent sample) and (3) we would not find significant moderation of the effect of IQ on Conscientiousness by achievement.

## 1. Method

### 1.1. Participants

We analysed data from the Minnesota Twin Family Study (MTFS) and Sibling Interaction and Behavior Study (SIBS).

MTFS is a community-based longitudinal study of same sex twins and their parents recruited using a population-based method (for a full description see Iacono, Carlson, Taylor, Elkins, & McGue, 1999). MTFS consists of two cohorts, one recruited originally when the twins were aged 11 years, and the other recruited originally when the twins were aged 17. Both cohorts have been followed longitudinally. Based on comparability to US Census data for Minnesota, the MTFS sample is generally representative of families with children living at home (Holdcraft & Iacono, 2004). Approximately 20% of invited participants declined to participate but more than 80% of this group agreed to complete a brief mail or telephone survey, allowing partial comparison of those who agreed to participate with those who did not. This comparison suggested a small difference in educational level, with the parents in participating families having on average an additional 0.3 years of education (for additional comparisons see Iacono et al., 1999).

SIBS is a community-based sample of pairs of adoptive and biological siblings and their parents recruited through adoption agencies. The families comprising the adoptive sample were selected to include an adolescent between the ages of 10 and 21 who was adopted before the age of 2 and a second adolescent who was not biologically related and was no more than 5 years older or younger. The parents in these families were generally representative of those accepting infant placements, but compared with Minnesota parents in the general population they were overall of higher socioeconomic status. The families in the biological families were recruited using birth records from the same area as the adoptive families. Fifty-seven percent of eligible biological families agreed to participate and 63% of eligible adoptive families agreed to participate but 90% of the mothers from the remaining families completed a brief telephone interview, allowing comparison of those who did and did not participate. These groups did not differ on either educational or occupational level among the adoptive families but mothers from the participating biological families were more likely to have a college degree than those from non-participating families (44% compared with an estimate of 39% for the comparison population of mothers in the geographical region).

Overall, therefore, the combined sample was slightly selected on parental education and socio-economic status but otherwise generally representative of individuals in the geographic region from which they were sampled.

#### 1.1.1. Adolescent sample

We used data from the 11- and 17-year-old MTFS cohorts and SIBS. We combined the data from the second wave of follow up in the 11-year-old cohort (targeting them at age 17) with the intake data from the other cohorts. Dependent on the data available on particular measures, we used different subsets of the total sample. The composition of these samples varied slightly but as an approximate guide, with complete data on the IQ and both measures of conscientiousness, there were 2412 participants (1100 males) with a mean age of 17.7 (SD = 0.69).

#### 1.1.2. Parent sample

We combined the parent data from the MTFS and SIBS cohorts, utilising data contributed at intake. Again, the specific subset of data used from the sample as a whole was dependent on the availability of particular measures. As an approximate guide, with complete data on the IQ and both of the conscientiousness measures, there were 3276 participants (1522 males) with a mean age of 42.5 (SD = 5.5).

### 1.2. Measures

#### 1.2.1. Multidimensional personality questionnaire (MPQ)

Conscientiousness was measured using a 198-item version of the multidimensional personality questionnaire (MPQ; Tellegen & Waller, 2008). The MPQ contains two conscientiousness-related traits: Control and Achievement. Here we re-label the Achievement scale 'Achievement-Striving' to avoid confusion with our measures of occupational and educational achievement. High scorers on Control describe themselves as reflective; cautious, careful, plodding; rational, sensible, level-headed; liking to plan activities in detail. High scorers on Achievement-Striving describe themselves as working hard, driving themselves; welcoming difficult and demanding tasks; persisting when others give up; ambitious; putting work and accomplishments before many other things; setting high standards; being perfectionistic. Items were measured on a 4-point response scale from 'Definitely True' to 'Definitely False' and each scale has 18 items. Here we utilised the scale scores for the two measures. Gaughan, Miller, Pryor, and Lynam (2009) reported the highest correlations of MPQ Control to be with the Order ($r = .56$) and Deliberation ($r = .68$) facets of Conscientiousness in the NEO-PI-R, whilst MPQ Achievement-Striving correlated most highly with the Achievement Striving ($r = .60$) and Self-Discipline ($r = .52$) facets.

#### 1.2.2. IQ

The IQ measure completed by participants was an abbreviated version of the Wechsler Adult Intelligence Scale Revised (WAIS-R; Wechsler, 1974) and included the Vocabulary, Information, Block Design and Picture Arrangement subtests. These subtests were chosen based on their high correlation (.90) with IQ derived from all the subtests.

#### 1.2.3. Educational and occupational achievement

For the adolescent sample we used grade point average (GPA) as a measure of educational achievement. To avoid problems of comparing grades across different school districts with different testing formats, procedures and standards, GPA was not computed from actual grades. Instead twins and their parents were asked to report, on a 5-point scale from 0 = failed class to 4 = much better than average, the grades typically received in language arts, maths, social studies and science classes. Here, GPA was the average across these ratings. This measure was validated against the actual school grades of a sub-sample of 67 randomly selected participants from the age-11 cohort and found to correlate with these at .89.

For the parent sample, we used occupational level according to the Hollingshead's (1957) occupational scale as a measure of occupational achievement. This is an eight-point scale ranging from 'unskilled' to 'major professional'. Higher ratings on the scale reflect higher levels of occupational achievement.

### 1.3. Statistical procedure

#### 1.3.1. Compensatory selection

Our methods of evaluating the correlation between IQ and our two measures of conscientiousness (Control and Achievement-Striving) were designed to mimic as closely as possible the methods that have previously been employed in the majority of previous studies finding negative associations between IQ and Conscientiousness (e.g., Moutafi et al., 2004). We, therefore, used Pearson's correlations between the scale scores on the personality measures and IQ. We dealt with missing data using pairwise deletion.

We introduced selection by discarding all individuals who were below progressively increasing thresholds of educational or occupational achievement. This was designed to mimic processes of selection into populations (e.g., undergraduate students, or assessment centre participants) to some degree dependent on educational or occupational achievement. We evaluated the correlations between IQ and our conscientiousness measure in the progressively more selected samples.

#### 1.3.2. Moderation analysis

We evaluated whether educational or occupational achievement moderated the effect of IQ on cognitive ability using multiple regression models. One model was estimated for each of the measures of Conscientiousness in each of the samples. In these models the predictors were IQ, Achievement (occupational level for the parent sample and GPA for the adolescent sample) and the interaction between IQ and Achievement. The outcome variable was the Conscientiousness measure (Control or Achievement-striving). IQ and Achievement were both centered prior to analysis. A statistically significant interaction term was considered to be evidence in favour of moderation of the relation between IQ and cognitive ability by achievement.

## 2. Results

### 2.1. Correlations in unselected samples

In the unselected adolescent sample there was no statistically significant association between IQ and Control ($r = .04$, $p = .06$) but a statistically significant positive association between IQ and Achievement-Striving ($r = .14$, $p < .01$). In the unselected parent sample there was a small but statistically significant positive association between IQ and Control ($r = .05$, $p < .01$) but no statistically significant association between IQ and Achievement-Striving ($r = .03$, $p = .15$).

### 2.2. Effect of selection on Conscientiousness–IQ association

Tables 1 and 2 show the correlations of IQ with the Control and Achievement-Striving personality scales when the full samples were subjected to selection on educational or occupational achievement. They show the downward trajectories of the correlations as samples became increasingly selected on achievement or

**Table 1**
Correlations between IQ and Conscientiousness at different levels of selectivity for educational achievement in adolescent sample.

| Selection criteria | IQ–Control correlation | | | IQ–Achievement-Striving correlation | | |
|---|---|---|---|---|---|---|
| | *r* | *N* | *p* | *r* | *N* | *p* |
| No selection | .04 | 2416 | .06 | .14 | 2417 | <.01 |
| GPA > 1 | .03 | 2285 | .09 | .15 | 2285 | <.01 |
| GPA > 1.25 | .03 | 2270 | .11 | .15 | 2270 | <.01 |
| GPA > 1.5 | .03 | 2240 | .14 | .15 | 2239 | <.01 |
| GPA > 1.75 | .03 | 2196 | .20 | .14 | 2195 | <.01 |
| GPA > 2 | .02 | 2066 | .47 | .13 | 2065 | <.01 |
| GPA > 2.25 | .00 | 1964 | .92 | .13 | 1963 | <.01 |
| GPA > 2.5 | −.02 | 1758 | .38 | .12 | 1758 | <.01 |
| GPA > 2.75 | −.02 | 1538 | .48 | .12 | 1539 | <.01 |
| GPA > 3 | −.04 | 1236 | .18 | .10 | 1237 | <.01 |
| GPA > 3.25 | −.05 | 1014 | .08 | .09 | 1014 | <.01 |
| GPA > 3.5 | −.07 | 662 | .07 | .10 | 663 | .01 |
| GPA > 3.75 | −.06 | 375 | .22 | .08 | 376 | .13 |

**Table 2**
Correlations between IQ and Conscientiousness at different levels of selectivity for occupational achievement in adult sample.

| Selection criteria | IQ–Control correlation | | | IQ–Achievement-Striving correlation | | |
|---|---|---|---|---|---|---|
| | *r* | *N* | *p* | *r* | *N* | *p* |
| No selection | .05 | 3280 | <.01 | .03 | 3277 | .15 |
| Semi-skilled and above | .04 | 2332 | .04 | .01 | 2329 | .61 |
| Skilled manual and above | .03 | 2247 | .15 | .00 | 2090 | .96 |
| Clerical, sales, technician, etc. and above | .02 | 1696 | .50 | .01 | 1694 | .74 |
| Minor professional and above | .01 | 1293 | .69 | −.05 | 1291 | .10 |
| Lesser professional and above | .01 | 743 | .79 | −.05 | 742 | .16 |
| Major professional and above | .03 | 269 | .64 | −.13 | 268 | .03 |

occupational achievement. This is depicted graphically in Figs. 1 and 2.

In the adolescent sample, the initial non-significant positive association between IQ and Control in the full sample ($r = .04$, $p = .06$) became steadily attenuated and then negative with selection on GPA. At the highest level of GPA, the association was $r = -.06$ ($p = .22$). A similar albeit more subtle effect occurred in the correlation between IQ and Achievement-Striving, which began at $r = .14$ ($p < .01$) and decreased to $r = .08$ ($p = .13$) in the most selected group.

In the parent sample, selection on occupational level had little effect on the correlation between IQ and Control. It reduced from

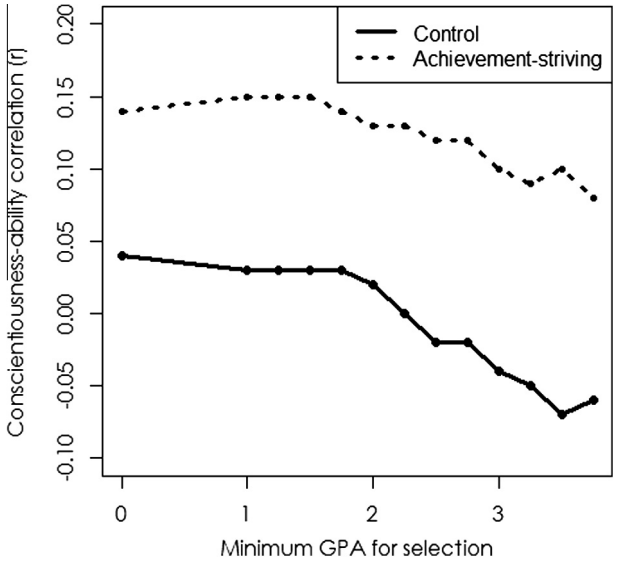


**Fig. 1.** Conscientiousness–IQ association at different levels of selection in adolescent sample.

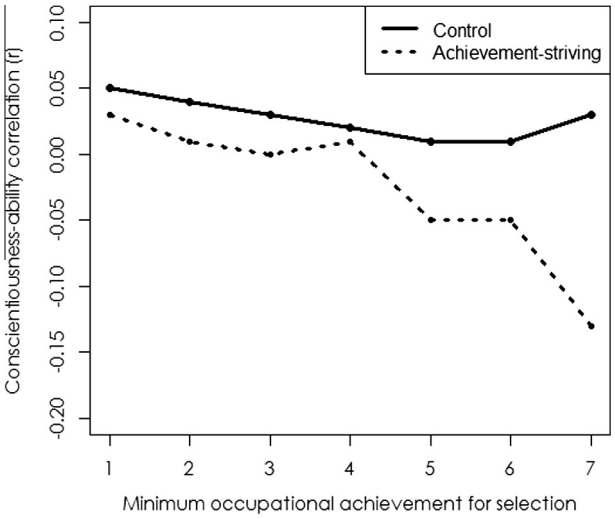


**Fig. 2.** Conscientiousness–IQ association at different levels of selection in parent sample.

.05 to .01 and then rose again to .03 at the highest level of selection. There was a more marked effect of selection on the correlation between IQ and Achievement-Striving. With increasing degrees of selection, it first became steadily attenuated to zero with and then became negative. Although there was no significant association between IQ and Achievement-Striving in the full sample, at the highest level of selection there was a statistically significant negative association ($r = -.13$, $p = .03$).

### 2.3. Moderation tests

There was no statistically significant interaction between IQ and GPA in predicting either Control ($B = 0.02$, $p = 0.32$), or

Achievement-Striving ($B = 0.04$, $p = 0.08$) in the adolescent sample. There was also no statistically significant interaction between IQ and occupational level in predicting either Control ($B = -0.00$, $p = 0.86$) or Achievement-striving ($B = -0.00$, $p = 0.62$) in the adult sample. These results suggest that achievement did not moderate the effect of IQ on Conscientiousness.

## 3. Discussion

We tested whether compensatory selection into research samples could explain why negative associations have been observed between conscientiousness and cognitive ability. Often these associations are explained in terms of an 'intelligence compensation hypothesis' in which lower ability individuals develop higher levels of conscientiousness to compensate for their lower ability. Many studies have, however, not found negative associations between IQ and Conscientiousness and those that do find negative associations have tended to comprise participants above certain levels of educational or occupational achievement.

We found no evidence for negative correlation in our large sample of adolescents and their parents. Unlike these previous studies, we utilised a sample in which only relatively trivial selection on educational or occupational achievement was likely. Where there were significant associations between IQ and conscientiousness in the full sample, these were positive rather than negative. In fact, there was a positive correlation between IQ and Achievement-Striving ($r = .14$) of an absolute magnitude comparable to the negative correlations reported in previous studies and interpreted as evidence for intelligence compensation (e.g., Moutafi et al., 2006).

Our results in the full (unselected) samples were consistent with other studies in no significant association or small positive associations have been observed between Conscientiousness and IQ (Bartels et al., 2012; Lounsbury et al., 2005; Luciano et al., 2006). Notably, like the current study, many of the studies do not appear to show evidence of substantial sample selection on achievement.

The general pattern of zero to small associations between IQ and conscientiousness in studies apparently not selected on achievement might suggest one of two causal scenarios at the level of the individual. Either there are only minimal causal impacts of IQ and conscientiousness on one another; or the impact of IQ and conscientiousness on one another is heterogeneous across individuals but close to zero in the aggregate as effects in opposite directions cancel out. For example, while some individuals of lower ability may develop increased conscientiousness in compensation, others of low ability may become discouraged by their failure to achieve on a par with their more able peers without intensified efforts. These latter individuals may grow to expend less effort in applying themselves conscientiously in response to the lower pay-off they receive for this behaviour. Conversely, the higher rewards for behaving conscientiously in more able individuals could lead to a greater reinforcement of this behaviour. A person's particular social environment (e.g., the rewards associated with intelligent and conscientious behaviour) in combination with their other traits (e.g., motivation, reward sensitivity, locus of control) will likely determine whether and how their level of intellectual ability and conscientiousness influence one another.

Soubelet and Salthouse (2011) have suggested that a possible influence on how personality traits and cognition relate to one another is a person's age. Our results support this prediction to some degree: only in our adolescent sample was a positive association observed between Achievement-Striving and IQ. A possible explanation for this is that adolescents are likely to be currently or recently in academic environments: social settings in which intellectual achievement is heavily measured and rewarded. The salience of intellectual achievement may foster social influences that result in enhancement of Achievement-Striving particularly in those individuals of higher cognitive ability for whom these rewards are more attainable with individuals of lower cognitive ability possibly becoming disheartened and demotivated. Such processes are likely to be governed by a 'frog pond' effect whereby it is not only the absolute level of intellectual ability of an individual that matters with regards to increases or decreases in conscientiousness, but also their level of cognitive ability relative to immediate peers (e.g., see Marsh, Trautwein, Lüdtke, Baumert, & Köller, 2007). Therefore, individuals who perceive their potential for achievement to be more limited because of their relative and absolute cognitive ability would be less likely to strive towards these achievements and thus score lower on Achievement-Striving.

Consistent with our compensatory selection hypothesis, we also found evidence that selecting on educational or occupational achievement biased the associations in the negative direction. In the adolescent sample, positive associations between IQ and the conscientiousness measures in the full sample were reduced to negative or effectively zero when restricting samples to high levels of GPA. In the adult sample there was little effect of restricting the sample to increasingly high levels of occupational achievement on the correlation between IQ and Control. Restricting the sample in this way, however, induced a negative and statistically significant association between IQ and Achievement-Striving in spite of there being no significant association in the full sample. This negative association was of a similar magnitude to those interpreted as evidence for intelligence compensation in previous studies.

We checked to see whether these selection effects simply indicated moderation of the relation between IQ and conscientiousness and ability. Moderation effects were very small and non-significant, suggesting that the effects of introducing selection into the samples did not reflect moderation effects.

We interpreted these collective results as suggesting that sample selection may have accounted for some previous observations of a negative association between conscientiousness-related traits and IQ. Although the effects were in some cases small, they were suggestive that differing degrees of selection on achievement could contribute to cross-study differences in the magnitude and direction of association between conscientiousness and IQ. Unfortunately, it is difficult to ascertain the precise selection processes that led to selection into the research samples in which negative Conscientiousness-IQ associations have been observed and we cannot be certain that these processes were closely approximated by our simulated selection. This is a general problem in observational research: it is uncommon for the selection processes leading to the composition of convenience samples to be explicitly considered, even less to be measured and modelled (see Hunt & Madhyastha, 2008 for a discussion). Unless such selection processes are given due consideration, researchers risk being misled as to the direction and magnitude of the associations between study variables.

Finally, while we have argued here that variability in sample selectivity on achievement may explain some of the heterogeneity in association between conscientiousness and ability in the published literature; this will not be the only factor influencing the magnitude of association. In particular, different lower-order facets of conscientiousness appear to show varying associations with IQ and it is possible to devise plausible substantive interpretations for these differential associations (e.g., Luciano et al., 2006). For example, the 'Competence' facet of Conscientiousness measures may be more positively related to IQ than other facets if it essentially acts as self-report measure of IQ (e.g., see Chamorro-Premuzic et al., 2005). Similarly, we have argued here that Achievement-Striving may be particularly influenced by IQ because motivation to achieve is likely to be influenced by self-perceptions of capacity to achieve. Depending on which facets

are measured and whether these are combined into a single Conscientiousness score will, therefore, affect the observed association with IQ.

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