

## RESEARCH ARTICLE

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# Conscientiousness and Cognitive Abilities: A Meta-Analysis

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### Abstract

This paper analyzes the current state of knowledge regarding the relationship between Conscientiousness and cognitive ability. The association between the two variables, the correlation between the sub-factors of Conscientiousness and cognitive ability and the impact of the sample type on the relationship were explored. Following a systematic literature review, 81 unique studies were identified. In terms of inclusion criteria, studies had to (1) report any link between Conscientiousness and cognitive ability, (2) conceptualize Conscientiousness through the Big Five model, and (3) report a measure of cognitive ability (regardless of conceptualization). Several random-effects meta-analyses were conducted, obtaining meta-analytical correlations of .02, -.06 and -.06 between Conscientiousness (global) and cognitive abilities (global), crystallized intelligence and fluid intelligence, respectively. Moreover, for the correlations between the facets of Conscientiousness and cognitive abilities, 6 random-effect models were carried out, however the evidence was statistically significant only in the case of order and achievement striving scales. Finally, the sample type was considered as a potential moderator of the relationship between conscientiousness and cognitive ability, but it was not supported by the available data. These findings were discussed within the context of the relevant literature and several limitations and directions for future research were also taken into consideration.

### Keywords

Conscientiousness, cognitive ability, Big Five, fluid intelligence, crystallized intelligence

Given that personality is at the root of human behavior, numerous studies focus on the relationship between it and various outcomes. Over time, research in the field has revealed a five-factor structure (e.g., Schmitt et al., 2007), which is currently the most used in personality evaluation. The five factors (openness to experiences, Conscientiousness,

extraversion, neuroticism, and agreeableness) have also become central constructs of the scientific literature, where their applicability is found in every branch of psychology. Among them, Conscientiousness is a key construct, as it is related to aspects such as physical health (Moffitt et al., 2011) or longevity (Kern & Friedman, 2008), but also to variables such as

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academic performance (Nofle & Robins, 2007), performance at work (Dudley, Orvis, Lebiecki, & Cortina, 2006) or leadership (Judge, Bono, Ilies, & Gerhardt, 2002). As Roberts, Lejuez, Krueger, Richards and Hill (2012) also mention, it may seem that in order to live a long, healthy, happy and successful life, we ought to look as closely as possible at Conscientiousness.

Alongside personality, cognitive abilities are equally central to the scientific literature. For instance, it is well-known and almost unanimously accepted that intelligence is the single most important predictor of job performance (e.g. Hunter & Schmidt, 1996; Schmitt, 2014). In short, the relationship between Conscientiousness and cognitive abilities has long been studied in the literature, within several disciplinary perspectives and with applicability in areas such as organizational, educational, cognitive psychology (e.g., Lang, Kersting, Hülshager, & Lang, 2010; Salgado, Moscoso, & Berges, 2013; Schmitt, 2014).

The current paper has three important objectives and subsequent contributions to the scientific literature. First, we comb through the inconsistencies and contradictory opinions (e.g., Luciano et al., 2006; Moutafi et al., 2006) of the research on the topic of Conscientiousness and cognitive abilities, when it comes to the association and the magnitude of the relationship. We answer to the current lack of consensus, through a systematic review and meta-analysis of the relevant literature. Given that both are primary constructs of the scientific literature, meta-analytically integrating the available findings and building consensus is warranted. Secondly, we turn to a more granular focus, and examine whether there is a difference between the narrow traits (i.e., facets) of conscientiousness and cognitive abilities. This endeavor contributes to identifying how each of the six components of Conscientiousness (i.e., order, sense of duty, deliberation, self-realization, self-discipline, competence) specifically relates to cognitive abilities, leading to a more comprehensive understanding of the entire construct, which is a theoretical contribution to the scientific literature. An additional benefit of examining the narrow traits of Conscientiousness in

relation to cognitive abilities lies in the enhancement of predictive validity. Based on the Brunswik symmetry, which describes the relationships between the levels of abstraction and aggregation certain constructs have and the conceptual correspondence between them (Wittman & Süß, 1999), comparing different levels of generalization for the same construct against the same predictor – in this case, cognitive abilities- could be particularly revealing when it comes to the predictive validity of the entire construct (Rammstedt et al., 2018). Finally, our work investigates a potential moderator (i.e., sample type) on the strength of the association between cognitive abilities and Conscientiousness, to determine whether the type of sample considered in the studies has any effect on the strength of association between the study variables. The importance of this endeavor is highlighted by the fact that it enables us to understand whether the relationship between cognitive abilities and Conscientiousness generalizes across study samples or is confined to specific criteria. Furthermore, it expands the work of Murray et al. (2014), who first brought this idea under question.

## **Conscientiousness**

Conscientiousness is defined as a spectrum of constructs that describe individual differences, in relation to the tendency to be self-possessed, responsible towards others, hardworking, orderly, and following the rules (Roberts et al., 2009). Conscientiousness is most often considered a personality trait, reflecting relatively enduring and automatic patterns of thoughts, feelings and behaviors that differentiate people from one another (Roberts & Jackson, 2008).

Although Conscientiousness is widely regarded in the literature as one of the five or six broad personality traits, there are contradicting opinions about the distinct number of facets it incorporates. Different models propose any number between two to eight sub-factors of personality (Costa & McCrae, 1992; Lee & Ashton, 2004; MacCann et al., 2009). This precise delineation of sub-factors is important because the different facets of Conscientiousness have differentiated relationships with other

variables, and the correlation between Conscientiousness and certain constructs is influenced by the number of facets taken into account.

The bulk of the scientific literature seems to be focused on six particular facets of Conscientiousness (i.e., order, sense of duty, deliberation, self-realization, self-discipline and competence). These sub-factors were initially proposed in the Big Five taxonomy and described in what follows (Costa & McCrae, 1992). Order measures the degree to which a person can remain organized, and has a major impact on the way in which the objectives of one's professional life are chosen and pursued. The sense of duty facet assesses the person's adherence to norms, as well as the degree to which moral principles and obligations are observed. The self-realization dimension refers to the degree to which an individual is preoccupied with personal achievement, but it can be a starting point for work addiction. Self-discipline captures one's ability to undertake and complete tasks, despite distractions and boredom. Deliberation captures one's tendency to carefully and lengthily consider all aspects involved in a certain context before acting, to be cautious. Finally, competence refers to the degree to which an individual feels capable and effective, and out of all the facets of Conscientiousness, it is the one that displays the greatest correlation with self-esteem and with a locus of the internal control (Costa & McCrae, 1991).

When it comes to how the Conscientiousness personality trait and its facets have been approached in research, two are the most often used measures, namely the NEO Personality Inventory (Costa & McCrae, 2008) and the HEXACO Scale (Lee & Ashton, 2018). The first is based on five-factor structure of personality, while the former on a six-factor model. We will briefly detail each measure in what follows.

The NEO Personality Inventory (Costa & McCrae, 2008) is perhaps the best-known measure of personality and, subsequently, of Conscientiousness. Based on the Big Five taxonomy, it is built around a five-factor conceptualization of personality, which further includes six sub-factors for the

Conscientiousness dimension (i.e., order, sense of duty, deliberation, self-realization, self-discipline and competence). Among the advantages of using NEO-PI-R are its good psychometric characteristics or the arrangement of several distinct facets, which allow for an internal validation of results (Quirk, et al., 2003). However, although the NEO-PI-R has an impressive amount of empirical data behind it, it also comes with several caveats, as its factors are based on confirmatory factorial analysis, which has several limitations. Most importantly, the mutual relationships between the items of the test that make up the factors are not explicitly modelled and are therefore ignored (Goekoop, et al., 2012). This could have a negative impact, as some of these interactions may be of disproportionate importance compared to others (for example, some items may be correlated with many or fewer other items, may show stronger or weaker correlations, explain more of the variation in the scores of the factors, or have causal dominance over others).

Compared to the NEO personality inventory, the HEXACO Scale (Lee & Ashton, 2018) is conceptualized around a six-factor model of personality, through the addition of the facet of honesty-humility. This is in contrast to the NEO model of personality, where the factor of honesty-humility is included in the agreeability and Conscientiousness (Anglim & O'Connor, 2018) dimensions. Within the HEXACO framework, the Conscientiousness factor has been described largely the same as the Five Factor Model Conscientiousness dimension (Lee & Ashton, 2018). One caveat is that in the case of the HEXACO model, the Conscientiousness factor is not operationalized by any terms that refer to a moral conscience in particular, such as "sincere" or "honest", as those are attributed to the honesty-humility dimension (Anglim & O'Connor, 2018).

### **Cognitive abilities**

Likely the most well-known and used model that describes human intelligence and cognitive abilities is the Cattell-Horn-Carroll

model (CHC; Roberts & Lipnevich, 2011). This model derives from the three-layer model proposed by Carroll (1993) and is also based on the theory of fluid and crystallized intelligence (Cattell, 1941; Horn, 1965). According to the CHC model, there are three layers: (1) layer I contains primary or narrow mental abilities (such as inductive reasoning or speed of reaction), (2) layer II is comprised of broader abilities (fluid intelligence and crystallized intelligence), and (3) layer III, is represented by the *g* factor (general intelligence). In this context, fluid intelligence refers to the vast ability to reason, form concepts and problem solving using familiar information to completely new procedures (Schneider & McGrew, 2012). This factor is very close to the *g* factor used by Carroll (1993). Crystallized intelligence (*Gf*) refers to the breadth and depth of knowledge acquired by a person, the ability to communicate knowledge and the ability to reason using previously learned experiences or procedures (Schneider & McGrew, 2012). Although the CHC model has been characterized as the most comprehensive and empirically supported psychometric model of the structure of cognitive abilities (McGrew, 2005), it is not without criticism. One of the main limitations of the CHC model refers to the way in which confirmatory factorial analysis was used in studies focusing on CHC theory. This questioned the empirical fundamentals of the model, as it was observed, for example, the constant use of small, unrepresentative samples (McGhee & Lieberman, 1994), such as the imposition of post-hoc adjustments to achieve the expected results (McGill & Dombrowski, 2019).

When it comes to measuring cognitive abilities, it should be noted that the vast majority of new and revised individually administered intelligence tests, are either based on the CHC Theory or are inspired by the CHC Theory (Keith & Reynolds, 2010). The Woodcock-Johnson test (WJ-R) was the first major intelligence test, administered individually, based on the Gf-Gc theory, and the Woodcock-Johnson III tests of cognitive abilities (WJ-III) were the first individual cognitive tests based solely on CHC theory (Woodcock, McGrew, & Mather, 2001). Another measure is the Stanford-Binet test,

which has probably changed more than any other intelligence test in its recent iterations. It goes from its classic format that mainly measures the *g*-factor, to a scale based, in part, on the Gf-Gc Theory in its fourth edition (Thorndike, Hagen, & Sattler, 1986), and finally back to a scale centered largely on the CHC theory in its fifth edition (Roid & Pomplun, 2005). Finally, an important place is taken by the Reynolds Intellectual Assessment Scales (RIAS; Reynolds & Kamphaus, 2003). RIAS is a relatively new intelligence test, and the CHC theory has been used as a theoretical guide in its development. Four subtests make up the basic scale, which was developed to provide a measure of *g*, as well as an evaluation of verbal and nonverbal intelligences (corresponding to crystallized and fluid intelligence, respectively).

### **Conscientiousness and cognitive abilities**

Currently there is a scientific lack of consensus when it comes to the relationship between Conscientiousness and cognitive abilities. The available evidence is split into three possible scenarios: either (1) no relationship (e.g., Bartels et al., 2012), (2) a negative association (e.g., Furnham & Moutafi, 2012; Moutafi et al., 2006; Soubelet & Salthouse, 2011); or (3) a positive, or small positive association (e.g., Baker & Bichsel, 2006; Luciano et al., 2006) between the two study variables.

In this meta-analysis, we subscribe to the Intelligence Compensation Hypothesis (ICH; Moutafi et al., 2004), as a potential explanation for the relationship between Conscientiousness and cognitive abilities. This posits that people displaying lower cognitive abilities tend to compensate by employing a higher level of Conscientiousness, so as to maintain a standard of performance comparable to that of people with higher cognitive abilities. What is more, individuals with a higher cognitive capacity do not feel the need to make a considerable effort, since they can easily accomplish any task. Based on the explanatory mechanisms of the ICH, as well as the body of scientific literature reporting a negative relationship between cognitive abilities and

Conscientiousness, we put forth the following hypothesis:

*Hypothesis 1:* There is a negative association between Conscientiousness and cognitive abilities.

It is equally important to study the link between the sub-factors of Conscientiousness and cognitive abilities. Such an investigation may provide a more nuanced perspective of the association between Conscientiousness and cognitive abilities and reveal the differential associations various facets might have with one's level of cognitive abilities. This pursuit could also while also bring more clarity around to the source of the insignificant negative relationship between the two variables. Furthermore, examining the effects of personality only at the level of factors can mask the effects at the facet level if they are in opposite directions (Ziegler et al., 2010). Similarly, the conceptualization of cognitive abilities only at their widest level (as general intelligence or *g*) does not take into account certain relationships that different cognitive abilities can have with Conscientiousness.

Based on the above considerations, we also advance the following hypothesis:

*Hypothesis 2:* The association between Conscientiousness and cognitive abilities differs depending on the facets of Conscientiousness.

We expect the facets of competence and sense of duty to be positively correlated with cognitive abilities. In the case of the former, this would be consistent with the scientific literature (e.g., Luciano et al., 2006). In other words, a person who has higher cognitive abilities would be more likely to be more confident in themselves and in the skills they have. When it comes to the latter, we posit that individuals who have higher levels of cognitive abilities would also have a more pronounced sense of duty, owing to their cognitive skills. This explanation has also been put forth in previous research (e.g., Rammstedt et al., 2018).

*Hypothesis 2a:* There is a positive relationship between competence and cognitive abilities.

*Hypothesis 2b:* There is a positive relationship between a sense of duty and cognitive abilities.

Since self-discipline captures the ability to undertake and complete tasks despite distractions, a higher level of cognitive abilities would facilitate this process so that the individual could set goals and channel their resources towards their intended purpose. Therefore, we advance the following hypothesis:

*Hypothesis 2c:* There is a positive relationship between self-discipline and cognitive abilities.

For two other sub-factors of Conscientiousness, deliberation and the self-realization, negative associations with cognitive capacity are expected. On the one hand, in terms of deliberation, the scientific literature reports a link between increased intelligence and more prompt responses to cognitive tasks (e.g. Jensen, 2006), which would imply a lower level of planning. Another explanation could be that those people who show a higher level of cognitive abilities create an adaptive mechanism of low deliberation that has led them to cope with the complexity of life. When it comes to the self-realization, the ICH Theory (Moutafi et al., 2004) might be applicable, suggesting that individuals with higher levels of cognitive abilities might be less inclined to prove themselves.

*Hypothesis 2d:* There is a negative relationship between deliberation and cognitive abilities.

*Hypothesis 2e:* There is a negative relationship between the self-realization and the cognitive abilities.

Finally, for the order subfactor, the relationship with cognitive abilities is expected to be positive or close to zero. The scientific literature hypothesized that persons with lower levels of cognitive abilities compensate through higher levels of organisation and planning (e.g., Moutafi et al., 2004; Rammstedt et al., 2016), however the evidence is mixed (e.g., Rammstedt, et al., 2018).

*Hypothesis 2f:* There is a positive relationship between order and cognitive abilities.

## Moderators

An in-depth understanding of the relationship between Conscientiousness and cognitive abilities should also account for potential moderating effects. We focus on the idea that the sample type could influence the relationship studied (Murray et al., 2014; Rammstedt et al., 2018). There is evidence (Murray et al., 2014) that the presence of a moderator in the relationship between conscientiousness and cognitive abilities could change its sign, or statistical significance. If samples are selected on the criteria of professional or academic performance, there will be a negative association between the two variables. For example, if the sample consists of students/employees, this also involves a certain level of performance or achievement that will influence the relationship. It has been suggested that this negative association could have been artificially created, because individuals with low cognitive abilities and/or low conscientiousness would be absent from such a sample (Murray et al., 2014). As a result, the true association between these constructs may be zero or positive at the population level, but the use of specially selected research samples for this purpose has sometimes led to the emergence of a negative association.

Almost all studies available in the scientific literature that investigate the relationship between Conscientiousness and cognitive abilities include populations of students/employees (e.g., Furnham et al., 2007), and as such these samples are relatively homogenous in terms of education, age, experience in the labor market and levels of cognitive abilities. A sample that is more representative of the adult population (which might include individuals with lower levels of Conscientiousness and cognitive abilities) could alter both the sign and statistical significance of the relationship. As such, it could happen that in the case of such a sample, the relationship between the variables could be positive, or absent. Based on the above, we suggest the following hypothesis:

*Hypothesis 3:* The sample type is a moderator of the relationship between Conscientiousness and cognitive abilities.

*Hypothesis 3a:* In the context in which the sample includes only student/employee

populations, Conscientiousness and cognitive abilities show a negative, statistically significant correlation.

*Hypothesis 3b:* In the context in which the sample is representative of the general population, Conscientiousness and cognitive abilities show a positive, statistically significant correlation.

## Method

### Search strategy

Two complementary approaches were used to identify relevant studies. To test the link between Conscientiousness and cognitive abilities, a systematic review of the literature on the relationship between Conscientiousness and cognitive abilities was conducted.

The search key used was: (Neuroticism) OR (Extraversion) OR (Openness) OR (Agreeability) OR (Conscientiousness) OR (Big Five) OR (Personality) OR (Five Factor Model) OR (Big 5) OR (NEOAC) OR (OCEAN) OR (Disposition) AND (Intelligence) OR (Cognitive Ability) OR (IQ) OR (Aptitude) OR (Reasoning) OR (Logical Thinking) OR (Analytical Thinking) OR (Inductive Thinking) OR (Processing Speed) OR (Mental Speed) OR (Divergent Thinking). The following databases were searched: JSTOR, Nature, Proquest, PsycInfo, ScienceDirect, Scopus, Springer, Web of Science, Wiley.

In addition, an ancestor search was used to examine references of influential articles on the topic being studied in search of other works that might be included in the meta-analysis. Databases for unpublished research (i.e., dissertations) were also sought to minimize the impact of the publication bias.

The search process took place until August 2022. There were no time constraints placed on the actual search. The search string was maintained exclusively in English, and no papers written in another language were included.

A total of 486 articles were downloaded from the searched databases, following the online screening of the title and abstracts. 53 duplicates were identified and removed, with 433 studies eventually preserved. 174 articles were further excluded after a more in-depth

screening of the abstracts. The remaining 259 works were further analyzed against the established inclusion and exclusion criteria (see below). In total, 178 articles were excluded in this step. The remaining 81 papers were included in the final analysis (see Figure 1).

## Coding

The data was encoded in an Excel spreadsheet, by the first and second author. Any disagreements were resolved qualitatively, through discussions, until full consensus was reached. The information collected was as follows: the author(s) and the year, sample size, sample information, type of design, the scale used to measure Conscientiousness, the scale used to measure cognitive abilities, as well as the correlation coefficients between each dimension of Conscientiousness and cognitive abilities. Where additional information was needed, every effort was made to find and include the missing data. There was no instance of missing data in the final database.

## Inclusion/exclusion criteria

The following three inclusion criteria were used:

First, studies should report the link between Conscientiousness and cognitive abilities, even if this is not the main objective of the work. The research that did not report correlations between sub-factors of Conscientiousness and cognitive abilities were not excluded. The use of this criterion led to the elimination of 96 studies.

Second, we only considered studies that operationalized Conscientiousness by the rigors of the Big Five taxonomy. However, there were no constraints on how it was measured, as we accepted any kind of measures that were based on the Big Five Model. The second criterion led to the elimination of 24 studies.

Third, we've only included studies that report a level of cognitive ability, regardless of how it was reported. Since in terms of cognitive abilities there is no consensus in the operationalization of the construct, studies using another way of reporting outside the

CHC model have not been excluded. The use of this criterion led to the elimination of 58 studies.

Lastly, we did not exclude any study based on the environment it was carried out, or the type of sample. As such, we have both employee and student samples available in the research.

## Data analysis

The data extracted from the remaining studies were centralized, and the effect sizes were calculated for each study, based on the sample and correlation coefficients. The results were converted to Z (Fisher) scores as a result of the abnormal distribution of Pearson's  $r$ . In the case of multiple effect sizes on individual studies, robust variation estimation was used. The standardized effect sizes were then weighted by their respective sample size. We then carried out several random-effects meta-analyses, using the Comprehensive Meta-Analysis software (version 3.3.070), for each of the six sub-scales of Conscientiousness and cognitive abilities.

Additionally, homogeneity was assessed using the Q statistic, as well as the the  $I^2$  values (Borenstein et al., 2011). The Q statistic represents the weighted sum of the square differences between the observed effect and the weighted average effect, and indicates a true heterogeneity in the effect studies, beyond random error. The  $I^2$  is a measure of the proportion of the observed variance, which is reflected in the actual differences of effect size. Unlike the Q statistic,  $I^2$  is not a measure that is sensitive to the number of studies included in the analysis (Borenstein et al., 2011). We considered a significant Q test result and a  $I^2$  value greater than or equal to 75% as significant. For results above this threshold, we analyzed the dispersion of the size of the actual effect, as well as its determinants. To this end, we further conducted moderator analyses.

Finally, we used the one study removed analysis to detect any potential extreme values, or any study that majorly influences the results obtained. In this vein, we also analyzed funnel diagrams to determine the existence of publication bias.

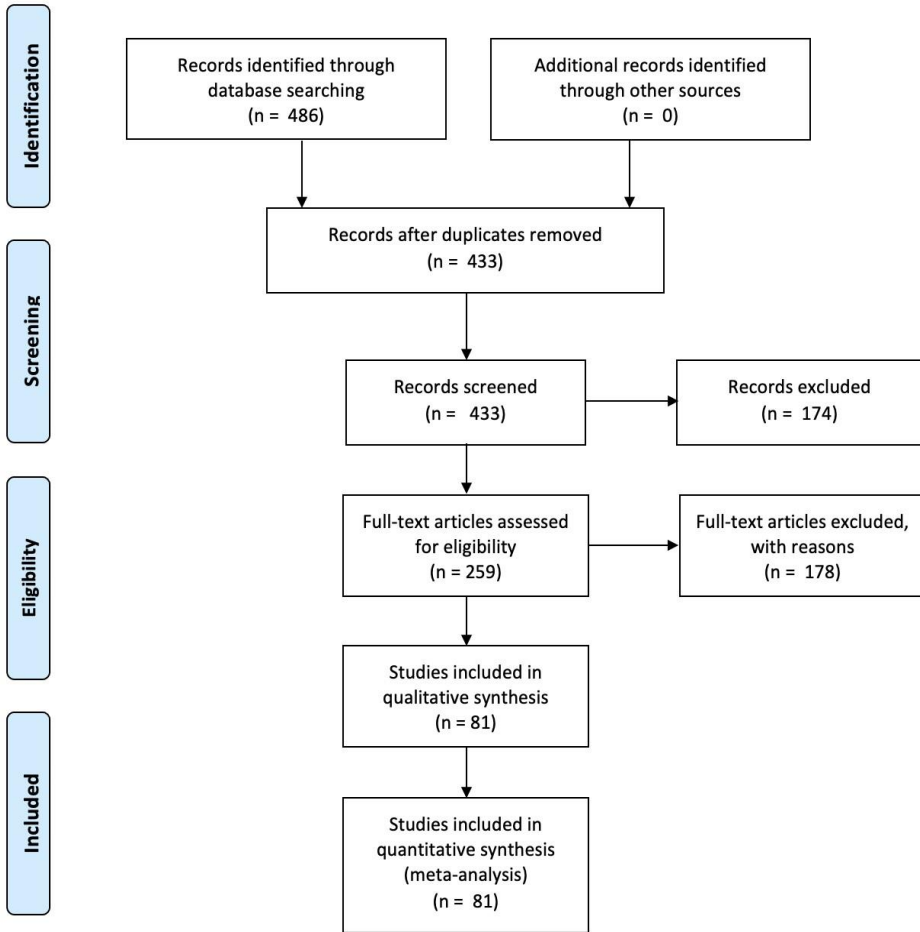


Figure 1. PRISMA diagram for the study selection process

## Results

### Characteristics of the studies

The analysis included 81 studies, with a total of 81 unique samples, and the number of participants ranged from 60 to 13648 (total  $N = 90685$ ). All studies have reported at least one correlation between Conscientiousness and cognitive abilities (either globally or at the facet level). Regarding the questionnaires used for Conscientiousness, 15 papers (18.52%) used the International Personality Item Pool (IPIP, Goldberg et al., 2006), 37 papers (45.68%) used NEO Five-Factor Inventory (NEO-FFI/NEO-PI-R, McCrae, Costa, & Martin, 2005), and 29 studies (35.8%) used another questionnaire.

Referring to cognitive abilities, 58 studies (71.6%) presented an overall cognitive ability score, and the remaining papers (28.4%) exclusively mentioned another level of cognitive abilities (e.g. fluid or crystallized intelligence) Among the measures used are the Culture Fair Test (Cattell, 1940), Raven's Progressive Matrices (Raven, Raven, & Court, 2000), the Wonderlic Personnel Test (Wonderlic, 1992), the Braddeley Reasoning Test (Braddeley, 1968), WAIS-III (Ryan & Lopez, 2001), etc.

### Overall effect sizes

The results of the analysis of the model on the link between Conscientiousness (global) and cognitive abilities (overall), on 58 independent

samples, showed a statistically insignificant relationship ( $r = .02$ ;  $p > .05$ ), with CI 95% ranging from  $-.01$  to  $.04$ . The Q value of the overall effect was significant ( $Q(57) = 384.62$ ,  $I^2 = 85.18$ ;  $p < .00$ ).

The results of the model analysis on the link between (global) Conscientiousness and crystallized intelligence, on 29 independent samples, showed a negative relationship, statistically significant ( $r = -.06$ ;  $p < .01$ ), with CI 95% ranging from  $-.10$  to  $-.02$ . The Q-value of the overall effect was significant ( $Q(28) = 334.69$ ,  $I^2 = 91.63$ ;  $p < .00$ ).

The results of the analysis of the model on the link between Conscientiousness (global) and fluid intelligence, on 31 independent samples, showed a negative, statistically significant relationship ( $r = -.06$ ;  $p < .01$ ), with CI 95% ranging from  $-.10$  to  $-.02$ . The Q-value of the overall effect was significant ( $Q(30) = 303.95$ ,  $I^2 = 90.13$ ;  $p < .00$ ).

Table 1 presents the relationship between Conscientiousness as a global construct and cognitive abilities.

Table 1. Meta analysis results between Conscientiousness (global) and cognitive abilities (global)

		N	r	CI	Q	I <sup>2</sup>
Conscientiousness	Cognitive Abilities	58	.02	[-.01;.04]	384.62**	72.29

Note: \*\*  $p < .01$

**Effect sizes on the dimensions of Conscientiousness**

In addition to analyzing the results of the models regarding the link between Conscientiousness (global) and cognitive abilities (global)/crystallized intelligence/fluid intelligence, we also investigated the relationships between the facets of Conscientiousness and global cognitive abilities.

The result was the analysis of the model on the link between order and cognitive abilities, on 7 independent samples, showed a negative, statistically significant relationship ( $r = -.06$ ;  $p < .05$ ), with CI 95% ranging from  $-.11$  to  $-.01$ . The Q value of the overall effect was significant ( $Q(6) = 37.39$ ,  $I^2 = 83.95$ ;  $p < .00$ ). Regarding the results of the model on the link between the sense of duty and cognitive abilities, on 6 independent samples, a statistically insignificant relationship was observed ( $r = -.01$ ;  $p > .05$ ), with CI 95% ranging from  $-.04$  to  $.02$ . The Q value of the overall effect was insignificant ( $Q(5) = 10.49$ ,  $I^2 = 52.32$ ;  $p > .05$ ).

In connection with the results of the model between deliberation and cognitive abilities, on

7 independent samples, a statistically insignificant relationship was obtained ( $r = -.02$ ;  $p > .05$ ), with CI 95% ranging from  $-.07$  to  $.04$ . The Q-value of the overall effect was significant ( $Q(6) = 38.71$ ,  $I^2 = 84.50$ ;  $p < .00$ ).

The results of the analysis of the model on the link between self-realization and cognitive abilities, on 6 independent samples, suggested a negative, statistically significant relationship ( $r = -.05$ ;  $p < .00$ ), with CI 95% ranging from  $-.08$  to  $-.02$ . The Q value of the global effect was insignificant ( $Q(5) = 10.63$ ,  $I^2 = 52.94$ ;  $p > .05$ ).

For the link between self-discipline and cognitive abilities, the analysis on 7 independent samples suggested a statistically insignificant relationship ( $r = -.06$ ;  $p < .01$ ), with CI 95% ranging from  $-.09$  to  $-.02$ . The Q-value of the overall effect was significant ( $Q(6) = 17.30$ ,  $I^2 = 65.31$ ;  $p < .01$ ).

Last but not least, the results of the analysis of the model on the link between competence and cognitive abilities, on 6 independent samples, captured a statistically insignificant relationship ( $r = .02$ ;  $p > .05$ ), with CI 95% ranging from  $-.02$  to  $.06$ . The Q value of the overall effect was significant ( $Q(5) = 18.04$ ,  $I^2 = 72.29$ ;  $p < .01$ ).

Table 2 presents the relationship between the facets of Conscientiousness and cognitive abilities.

Table 2. Meta analysis results between Conscientiousness facets and cognitive abilities (global)

Facet	N	<i>r</i>	CI	Q	<i>I</i> <sup>2</sup>
Order	7	-.06*	[-.11; -.01]	37.39**	83.95
Sense of duty	6	-.01	[-.04; .02]	10.49	52.32
Deliberation	7	-.02	[-.07; .04]	38.71**	84.50
Self-realisation	6	-.05**	[-.08; -.02]	10.63	52.94
Self-discipline	7	-.06	[-.09; -.02]	17.03**	65.31
Competence	6	.02	[-.02; .06]	18/04**	72.29

Note: \* $p < .05$ ; \*\*  $p < .01$

### Moderator effects

We also wanted to see if the type of sample (e.g. students, employees, general population, children) influences the relationship between Conscientiousness (global) and cognitive abilities (overall), using a mixed effects model, in which the dimensions of the effect are taken as a variable with random effects. The results obtained indicate that the sample type does not moderate the relationship between Conscientiousness (global) and cognitive abilities (global) ( $Q(57) = 384.62$ ,  $p > .05$ ).

### Publication bias

To investigate whether publication bias was present, we generated and examined the Funnel plots. At the same time, we also ran the trim-and-fill procedure (Duval & Tweedie, 2000), with a random effects model. We performed these analyses for all six dimensions of Conscientiousness.

For the order dimension, the trim-and-fill procedure added one estimated study, with an effect size smaller than the average, which does not significantly influence the results ( $r = -.04$ ;  $CI = [-.09; .02]$ ,  $Q = 53.13$ ). The results obtained are consistent with the Funnel plot (Figure 2).

For the dimensions of sense of duty (Figure 3), deliberation (Figure 4), self-

realization (Figure 5), self-discipline (Figure 6) and competence (Figure 7) the trim-and-fill procedure did not estimate any study with an effect size smaller than or larger than the average, which could influence the results obtained.

Overall, the results obtained do not indicate the presence of the publication bias in the sample included, in any of the six dimensions of Conscientiousness that were examined.

### Discussions

This meta-analysis examined the relationship between Conscientiousness (conceptualized through the Big Five model, along with its six facets) and cognitive abilities. A systematic review of the literature was carried out, and the meta-analysis incorporated 81 studies (with a total of  $N = 90685$  participants, from samples of students, children, adults, and the general population). The influence of one moderator, namely the type of sample, on the relationship between the two variables was also investigated.

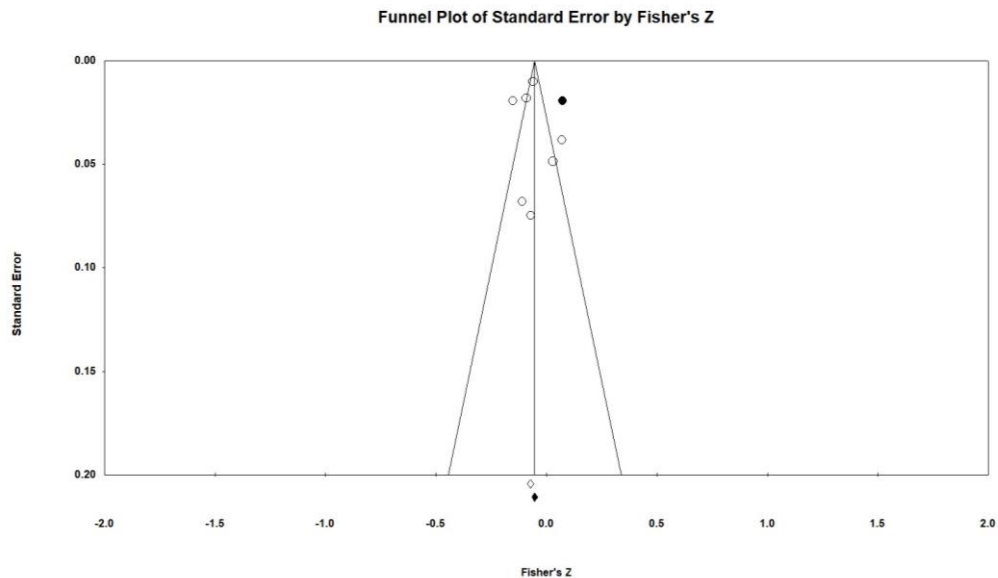


Figure 2. Funnel diagram for publication bias of order dimension and cognitive abilities, on 7 independent samples

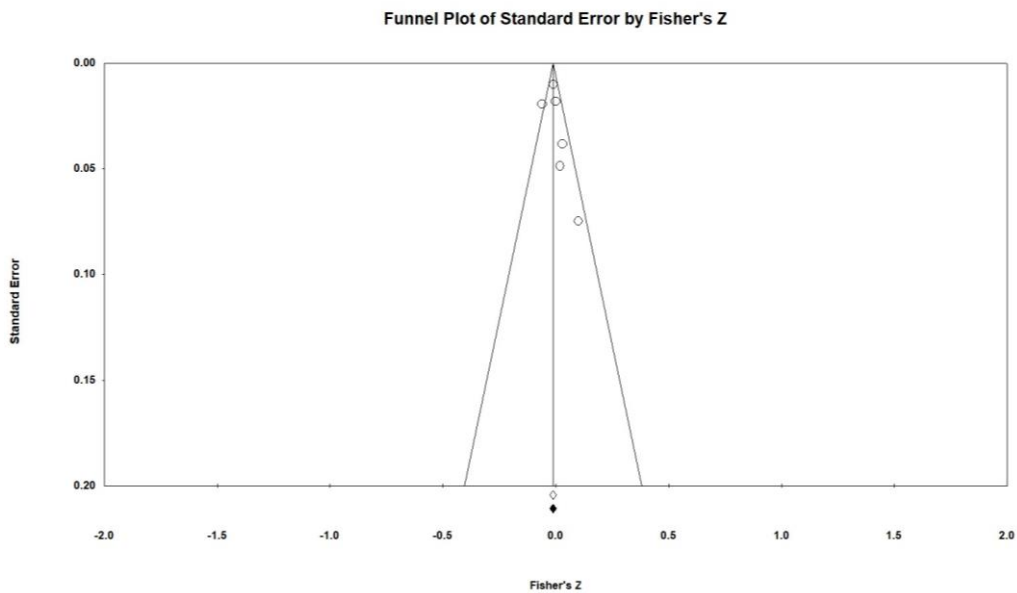


Figure 3. Funnel diagram for the publication bias of the sense of duty dimension and cognitive abilities, on 6 independent samples

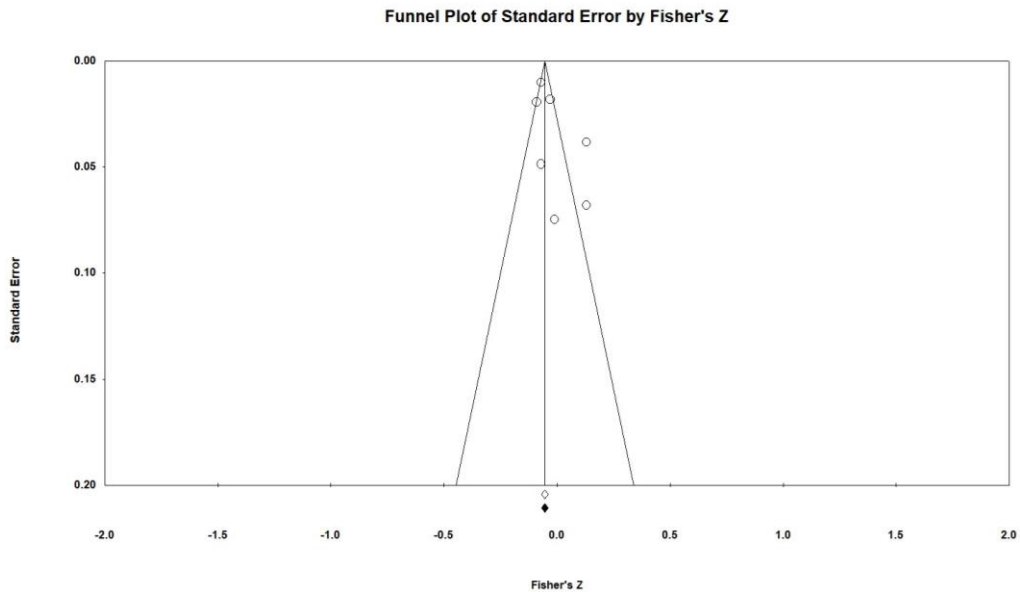


Figure 4. Funnel diagram for publication bias of the deliberation dimension and cognitive abilities, on 7 independent samples

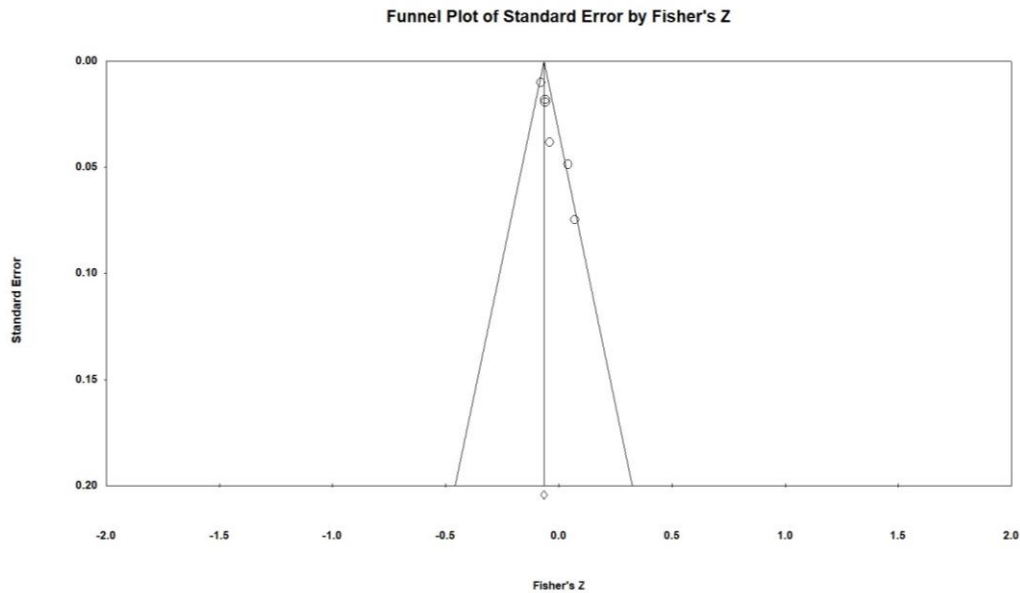


Figure 5. Funnel diagram for the publication bias of the self-realization dimension and cognitive abilities, on 6 independent samples

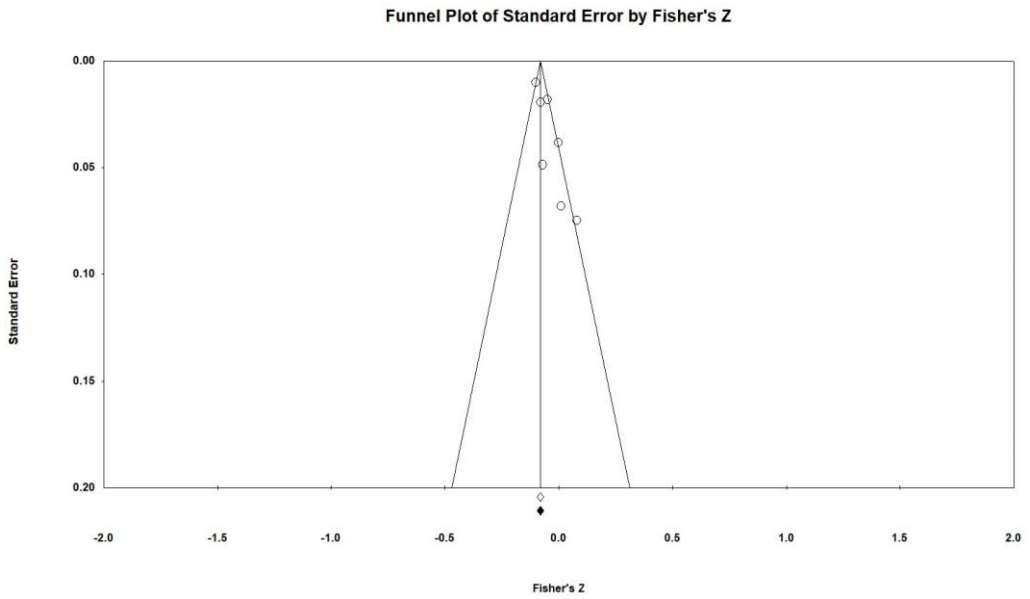


Figure 6. Funnel diagram for the publication bias of the self-discipline dimension and cognitive abilities, on 7 independent samples

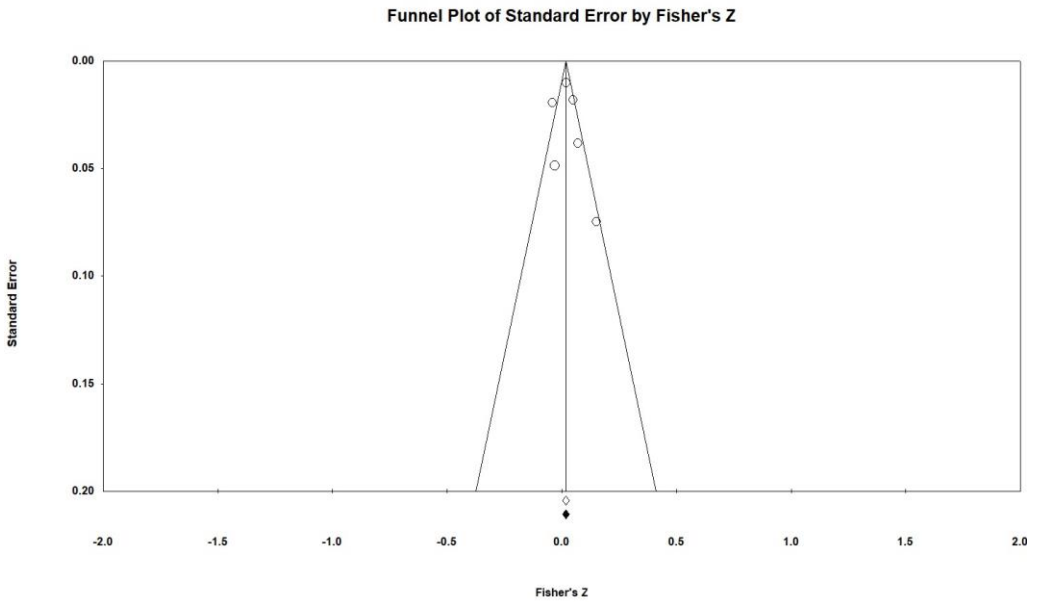


Figure 7. Funnel diagram for the publication bias of the competence and cognitive abilities dimension, on 6 independent samples

## Main effects

Regarding the relationship between consciousness and cognitive abilities, the meta-analysis revealed a statistically insignificant association, close to zero, between the two variables, which is in dissonance with the first hypothesis of the work (*H1*). The results obtained are in line with other findings in the literature (e.g., Bartels et al., 2012), who argue that, for the general population, it is very likely that there will be no connection between these two constructs.

However, since there have been studies that have wanted to observe, in more detail, the relationship between Conscientiousness and cognitive abilities, we have also traced the associations between Conscientiousness and the two more prominent components of intelligence – fluid and crystallized intelligence. Both relationships reported a negative, statistically significant association, and the results are consistent with previous studies such, as Wood and Englert's work (2009) and support the Intelligence Compensation Hypothesis.

## Sub-dimension effects

As illustrated in H2, we wanted to analyze the different relationships that the six facets of consciousness and cognitive abilities report in the literature.

The results obtained partially supported H2a, as although a positive association between competence and cognitive abilities was observed, it was statistically insignificant. The results are similar to other findings in the literature (e.g., Carretta et al., 2018; Furnham et al., 2007). Although we expected the association to be significant, it seems that a person who has higher cognitive abilities is not necessarily and more self-confident. A possible explanation is given by the existence of variables with a potential moderator effect, for example self-efficacy (Lumbantobing, 2020).

Regarding the relationship between the sense of duty and cognitive abilities, the proposed hypothesis (H2b) was not supported by the data, as the association was not statistically significant. There are similar results in the scientific literature (e.g.,

Furnham et al., 2007) and a possible explanation would be the interposition of variables such as compliance with the norms.

In the same vein, the H2c hypothesis was not supported by the data either, the relationship between self-discipline and cognitive abilities being statistically insignificant. Such an idea is also proposed by Kretzschmar, Spengler, Schubert, Steinmayr and Ziegler (2018), who argue that, at a more thorough glance, there is no connection between the facets of Conscientiousness and cognitive abilities. It is possible that the insignificant association is due to factors that influence the relationship, such as the need for realization. If the person does not identify a need for achievement that facilitates the completion of tasks despite potential distractions, the relationship between self-discipline and cognitive abilities will be insignificant.

In relation to the H2d hypothesis, it was partially supported by the data, since although the relationship between deliberation and cognitive abilities is negative, it is statistically insignificant. Although we expected a greater correlation between the two variables, it seems that the hypothesis is only partially supported by the results obtained. This is consistent with some other findings in the scientific literature (e.g., Jensen, 2006).

For the relationship between self-realization and cognitive abilities, the hypothesis (H2e) was supported by data, which supports the Intelligence Compensation Hypothesis. The results obtained are consistent with studies such as the ones carried out by Furnham et al. (2007) or Zajenkowski and Stolarski (2015).

Last but not least, the H2f hypothesis was not empirically supported, as the relationship between order and cognitive abilities was a negative one, statistically significant. Moutafi's work, Furnham & Crump (2006) There is evidence which suggests the idea and argues the negative relationship through the prism of the Intelligence Compensation Hypothesis (Moutafi et al., 2006).

## Moderator effects

Based on the H3 hypothesis, we investigated whether the sample type could influence the

relationship between Conscientiousness (global) and cognitive abilities (globally), since the scientific literature claims that the negative relationship between the two variables is only present in student or employee populations. Contrary to our expectations, the sample type is not a moderator of the studied relationship, so H3 is not supported by the data. It may be that other variables (e.g. the sequence of realization) influence the relationship, this aspect being proposed by authors such as Moutafi, Furnham and Paltiel (2004). It is, however, difficult to capture the effects of this moderator, as there are few studies that have also reported levels of desire to realize.

### **Theoretical contributions**

The contributions the present systematic review and meta-analysis brings to the current state of knowledge are threefold. Firstly, it provides a comprehensive analysis of all the currently available research on the topic of Conscientiousness and cognitive abilities, and generates consensus on this relationship. Following this analysis, the available data meta-analytically revealed no association between the study variables. This finding supports the argument of the Compensation of Intelligence Theory (Moutafi et al., 2004), which posits a negative, or at the very least no relationship between the Conscientiousness personality trait and cognitive abilities.

Secondly, by focusing on both the global constructs, as well as their dimensions, this paper adds to the completeness of the scientific literature. This meta-analysis tracked the relationship between the facets of Conscientiousness and cognitive abilities, which is useful in revealing the differential effects each of the dimensions has when it comes to cognitive abilities. This provides a more detailed understanding of the conscientiousness concept as a whole, as well as which particular aspects relate to cognitive abilities, and at what levels of generalization. Out of the six facets studied, only two (i.e., order and self-realization) revealed statistically significant, albeit negative, associations with cognitive abilities. The other four dimensions of conscientiousness (i.e.,

sense of duty, deliberation, self-discipline, and competence) were not statistically significant correlates of cognitive abilities.

Finally, this work contributes to the scientific literature by examining and discussing Conscientiousness and cognitive abilities on a broader level. One of the critiques that was frequently brought up in this line of research was that papers often employ samples which are comprised of some form of academic or professional performance (Murray et al., 2014), which will naturally skew the results. In contrast, the current paper is not limited to student/employee populations, but takes into account children, adults or even the general population of some countries, which increased the generalizability of the findings. In addition, examining the sample composition as a potential moderator of the relationship between Conscientiousness and cognitive abilities provides a broader understanding of the samples and population types where this effect could have occurred (Murray et al., 2004).

### **Practical implications**

The results achieved are also relevant for practitioners. In this way, some implications can be extracted. For example, while some individuals with lower cognitive abilities may develop an increased Conscientiousness to compensate, others with low cognitive abilities may be discouraged by the possibility of failure. The latter may end up putting in less effort and getting less conscientiously involved as a result of the fact that this behavior brings them a lower gain. Conversely, greater rewards for conscientious behavior in individuals with high cognitive abilities could lead to greater reinforcement of this behavior. A person's social environment (for example, the rewards associated with intelligent and conscientious behavior) in combination with the other traits of the individual (e.g., motivation, sensitivity to reward, place of control) will likely determine whether and how Conscientiousness and cognitive abilities will relate.

## Limitations and future research directions

Like any meta-analysis, this paper presents several limitations in terms of the studies included in the analysis. First, the vast majority of studies use a cross-sectional design, which does not allow for causal inferences. Secondly, another limitation of the meta-analysis is that we have not corrected for reliability, either for Conscientiousness and its facets, or for cognitive abilities. This may determinate a downward bias in the size of the observed effect (Wiernik & Dahlke, 2020). Thirdly, most of the measures used in studies to assess Conscientiousness were self-report, which may mean that the collected answers could be biased favorably.

In terms of future directions, it is preferable for studies in the field to focus more on the relationship between the narrow features of Conscientiousness and cognitive abilities, as it would facilitate a better understanding of the association between the two constructs. One could also explore the possibility of having a curvilinear relationship between Conscientiousness and cognitive abilities.

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