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Facets of conscientiousness and their differential relationships with cognitive ability factors

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ABSTRACT

This study examined relationships between conscientiousness facets and both broad factors of cognitive ability and collegiate GPA. Students responded to 117 Conscientiousness items and 15 cognitive tests demarcating fluid intelligence, crystallized intelligence, quantitative reasoning, visual processing, and broad retrieval ability. Confirmatory factor analysis replicated the eight-factor model found in MacCann, Duckworth, and Roberts (2009). Conscientiousness facet correlations with Cognitive Ability and GPA revealed that Cautiousness exhibited the highest correlation with Cognitive Ability, while Industriousness showed the strongest relationship with GPA. Procrastination Refrainment was the only facet negatively related to Cognitive Ability. Implications of these results are discussed in light of previous research and the potentially moderating effect of high- versus low-stakes testing on the relationship between conscientiousness and cognitive ability.

1. Introduction

There is an established literature showing that cognitive ability (intelligence) and Conscientiousness represent two of the strongest psycho-educational predictors of performance both at school and on the job (e.g., Barrick & Mount, 1991; Poropat, 2009; Schmidt & Hunter, 1998). However, there is only limited research examining the relationship between cognitive ability and Conscientiousness, and none (to our knowledge) considering lower-order constructs found in *both* cognitive ability and personality models. A complete investigation of the relative roles of Conscientiousness and cognitive abilities in predicting performance should examine how the facets of Conscientiousness are associated with the broad second-stratum factors of cognitive ability. This is the goal of the current study, which examines the associations of the eight-facet Conscientiousness model of MacCann, Duckworth, and Roberts (2009) with five second-stratum cognitive abilities from Cattell-Horn-Carroll (CHC) theory of cognitive abilities (McGrew, 2009).

1.1. The elements of conscientiousness

Conscientiousness emerged as a distinct factor in early research based on the lexical hypothesis, which states that important differences between people are encoded in single-word trait terms such that factor analysis of trait adjectives will uncover personality structures (e.g., Goldberg, 1990). While researchers agree that Conscientiousness is one of five or six broad domains of personality, there is considerable divergence of opinion on how many distinct facets it comprises. Different models variously propose that Conscientiousness consists of anywhere from two to eight facets (e.g., Costa & McCrae, 1992; DeYoung, Quilty, & Peterson, 2007; Lee & Ashton, 2004; MacCann et al., 2009; Peabody & De Raad, 2002; Roberts, Chernyshenko, Stark, & Goldberg, 2005; Saucier & Ostendorf, 1999). This precise delineation of facets is important because different facets of Conscientiousness show differential relationships to other variables, including valued life outcomes such as job performance and academic achievement (e.g., Judge, Rodell, Klinger, Simon, & Crawford, 2013; Luciano, Wainwright, Wright, & Martin, 2006; MacCann et al., 2009). Whether a link between Conscientiousness and outcomes is found may thus depend on which facets of Conscientiousness are considered. Moreover, different facets of Conscientiousness may show

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differential relationships with cognitive ability, broadly defined. For example, Luciano et al. (2006) found that the Dutifulness and Competence facets of the NEO-PI-R were significantly associated with cognitive ability, whereas the other four were not. The degree of association the facets share with cognitive ability is also important, as this affects the interpretation of the conscientiousness/outcome relationships, particularly for outcomes such as job performance and academic achievement that are known to relate to cognitive ability. That is, some facets of Conscientiousness may show *incremental prediction* over cognitive ability, whereas others may not.

1.2. The elements of cognitive ability

The most widely accepted psychological theory of cognitive ability is CHC theory (e.g., Roberts & Lipnevich, 2011). This model is derived from the commonalities among Carroll's (1993) three-stratum model and the Theory of Fluid and Crystallized Intelligence (Gf/Gc theory). Carroll's (1993) model was derived from re-analysis of nearly 500 data sets, and proposed three levels of abstraction at which cognitive ability should be considered. Stratum I consists of primary mental abilities (PMAs), which are very specific. For example, general sequential reasoning, inductive reasoning, reading comprehension, and spelling ability are PMAs. Stratum II consists of broader groupings of ability. For example, fluid intelligence (Gf; fluid reasoning) encompasses the PMAs of general sequential reasoning and inductive reasoning (as well as other PMAs), and crystallized intelligence (Gc; acculturated knowledge) encompasses the PMAs of reading comprehension and spelling ability (as well as other PMAs).

Carroll (1993) proposed eight of these second-stratum factors. Stratum III consists of general intelligence (*g*), which encompasses all eight of the second-stratum factors. In its most recent conceptualization, CHC theory consists of ten Stratum II cognitive ability factors, with a further six to seven factors that are still tentatively defined (e.g., MacCann, Joseph, Newman, & Roberts, 2014; McGrew, 2009). Both exploratory and confirmatory factor methodologies also support this structural model (e.g., Roberts et al., 2000). In this study, we will focus on five of these broad factors: crystallized ability (Gc), fluid ability (Gf), quantitative reasoning (Gq), retrieval ability (Gr), and visual-spatial ability (Gv).

1.3. The relationship between conscientiousness and cognitive ability

Recent work has predominantly found either no relationship or a negative relationship between cognitive ability and Conscientiousness. Table 1 summarizes 14 such papers examining the relationship between conscientiousness and cognitive ability published since 1997. These include two meta-analyses (Ackerman & Heggestad, 1997; von Stumm, Hell, & Chamorro-Premuzic, 2011). In order to quantitatively summarize the overall relationship found in the literature between Conscientiousness and cognitive ability, we aggregated the previously reported correlation coefficients displayed in Table 1 using the Hunter and Schmidt (2004) random-effects method.[1] Two trends were apparent. First, the mean sample-weighted correlation between cognitive ability and Conscientiousness was very small and negative (−.07) with 95% credibility interval lower and upper bounds of −0.14 and −0.01, respectively. A chi-square test of homogeneity indicated there was considerable variation in effect sizes overall, $\chi^2(13) = 161.17$, $p < .05$. These results were consistent with previous meta-analyses containing the correlation between cognitive ability and conscientiousness, where similar findings were reported by way of the relationship between cognitive ability and conscientiousness appearing small in magnitude (ρ = −.05 to .08; Ackerman & Heggestad, 1997; von Stumm et al., 2011). Second, although cognitive ability is often differentiated into group factors (e.g., fluid and crystallized intelligence), Conscientiousness is rarely investigated at the level of its lower-order facets. Such an investigation would provide a more nuanced view of the overall association between cognitive ability and Conscientiousness, potentially disentangling the source of the negative and low-magnitude correlations. Rephrased, a near-zero relationship could indicate that all Conscientiousness facets are unrelated to cognitive ability, but could also be reflective of (for example) half of the facets demonstrating a positive relationship, while the other half demonstrated a negative relationship. Examining personality effects at only the domain level can mask facet-level effects if these are in opposing directions (e.g., Ziegler, Danay, Scholmerich, & Buhner, 2010). Similarly, conceptualizing cognitive ability only at its broadest general level (as general ability, or *g*) does not account for the different relationships that different cognitive abilities demonstrate with personality (e.g., Ackerman & Heggestad, 1997).

1.4. The current study

A comprehensive examination of the associations of Conscientiousness facets with cognitive abilities appears to have not been previously undertaken. This is the primary aim of the current paper – to examine whether relationships between Conscientiousness and Cognitive Ability differ across the facets of Conscientiousness or the group factors of Cognitive Ability. We use the eight-facet Conscientiousness scale of MacCann et al. (2009), created through structural analyses of a comprehensive sampling of Conscientiousness items from the International Personality Item Pool (IPIP; Goldberg et al., 2006). The eight facets identified included Industriousness, Perfectionism, Tidiness, Procrastination Refrainment, Control, Caution, Task Planning, and Perseverance.

We had two supplementary objectives in this work beyond examining associations between facets of both Conscientiousness and Cognitive Ability. First, we tested the fit of the eight-factor structure of Conscientiousness identified by MacCann et al. (2009) in a larger, older, and less range-restricted (in terms of both age and socioeconomic status) sample than that used to develop the model originally. In order to provide discriminant validity evidence for the eight-factor structure in the current sample, we also considered associations between the eight Conscientiousness facets and the other four major domains of personality (Agreeableness, Extraversion, Neuroticism, and Openness). Second, we considered the differential prediction of academic achievement by the different Conscientiousness facets. A recent comprehensive meta-analysis of the relationship between personality factors and job performance demonstrated that different facets of Conscientiousness were differentially predictive of job performance (Judge et al., 2013). Specifically, the Achievement Striving facets showed a corrected correlation more than double that of the Order facet (.23 versus .11). Researchers predicting academic achievement using facets of Conscientiousness have reported similarly variant findings. Paunonen and Ashton (2001) found that GPA correlated at .26 with Achievement Striving but −.02 with Order. MacCann et al. (2009) found that the relationship of academic honors with Conscientiousness was more than six times stronger for the Industriousness facet than for Tidiness (ordering of one's possessions, conceptually similar to Order). We expected this type of finding would be replicated in the current study when considering relationships between facets of Conscientiousness and university grades.

[1] To avoid redundancy, this calculation omits results from the two prior meta-analyses (Ackerman & Heggestad, 1997; von Stumm et al., 2011).