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Cognitive ability, self-assessed intelligence and personality: Common genetic but independent environmental aetiologies

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ABSTRACT

Self-perceived abilities (SPA), which play an important role in academic achievement, have been recently reported to be fully attributable to genetic and non-shared environmental influences. To replicate and extend this finding, 732 Croatian twins (15–22 years old) were assessed on cognitive ability, self-assessed intelligence (SAI), and Five Factor Model personality traits. In addition to attempting to replicate the finding that SAI is due to genetic and non-shared environmental influences, we used bivariate and multivariate genetic analyses to investigate genetic and environmental influences on the phenotypic association of IQ, SAI, and personality traits. The results replicated the finding that individual differences in SAI can be attributed to genetic and non-shared environmental influences. Bivariate and multivariate genetic analyses showed intelligence, SAI measures, and personality traits are inter-correlated not only at the phenotypic but also at the genotypic level. Multivariate analyses indicate that around 20% of IQ variance could be explained by SAI and personality traits (Neuroticism, Extraversion, Openness). In combination with other recent findings from behavior genetics, this result supports the idea of pleiotropy and generalist genes.

1. Introduction

Even though general intelligence is one of the "most central phenomena in all of behavioral science, with broad explanatory powers" (Jensen, 1998, p. xii), it is widely recognized that factors other than cognitive ability constitute important performance determinants. Most notably, personality traits, typically conceptualized in terms of the Five Factor Model (e.g. Costa & McCrae, 1992) and self-assessed intelligence (SAI) – how intelligent people think they are – are empirically supported as factors that individually add incremental validity to intelligence for the prediction of educational achievements (e.g. Chamorro-Premuzic, Harlaar, Greven, & Plomin, 2010; Spinath, Spinath, Harlaar, & Plomin, 2006). These variables operate, however, not independently and are therefore likely to also have common aetiologies. To understand the causes of inter-relations between intelligence, the Five Factor Model personality traits and SAI, we examine here the genetic and environmental influences that may underlie their phenotypic associations.

1.1. Phenotypic associations

Correlations between IQ test scores and self-estimates of ability typically range between .20 and .50 (e.g. Ackerman & Wolman, 2007; Mabe & West, 1982), which has been used to both confirm and reject the hypothesis that people are able to assess their own intelligence quite accurately. Less disputed is the observation that IQ and self-estimated ability are inter-related predictors of academic performance, each with independent incremental validity (e.g.

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Chamorro-Premuzic & Arteche, 2008; Spinath et al., 2006). Positive effects of self-estimated ability on actual achievement have been consistently reported, even when the psychometric measurement of self-estimates differs across studies. For example, SAI is commonly measured by asking individuals to estimate their IQ on a bell curve of intelligence with a mean of 100 and a standard deviation of 15, whereas self-perceived abilities are often assessed with reference to the school or university curriculum (cf. Spinath et al., 2006). Those differences aside, it has been shown that SAI, academic self-beliefs and related constructs are highly inter-correlated and may be used interchangeably (Peterson & Whiteman, 2007).

In a recent study testing 5957 British school children, self-perceived ability at age 9 was strongly associated with concurrent academic achievement, after controlling for cognitive ability (Chamorro-Premuzic et al., 2010). Moreover, self-perceived ability at age 9 significantly predicted academic achievement and ability perception three years later at age 12, after controlling for academic achievement at age 9 and intelligence at age 9 and 12 (Chamorro-Premuzic et al., 2010). These results have two important implications: (1) self-estimates of ability are stable, trait-like individual difference variables that (2) play a crucial role for academic achievement, and therefore should be further investigated.

Several previous studies have examined SAI and its relationships to the Five Factor Model, reporting mostly positive associations with the personality traits of Extraversion and Openness to Experience, and negative links with Neuroticism and Agreeableness (e.g. Chamorro-Premuzic, Moutafi, & Furnham, 2005; Furnham, Chamorro-Premuzic, & Moutafi, 2005; Furnham, Kidwai, & Thomas, 2001). Observed correlations between Five Factor Model and SAI are typically explained as consequences of the personality trait in question, without reference to actual ability. For example, it has been suggested that neurotics' generally poorer self-concept causes reduced confidence in their aptitude, which is reflected in lower SAI (Chamorro-Premuzic et al., 2005). Based on similar reasoning, extraverts' inherent confidence and assertiveness is thought to lead to higher SAI (Furnham et al., 2005), whereas more agreeable individuals may report lower SAI because of their greater humility and modesty. In contrast, theories explaining positive associations between Openness and SAI typically make reference to actual cognitive ability. Because Openness to Experience is the only Five Factor Model trait that shows stable, albeit moderate, associations with general intelligence (e.g. Ackerman & Heggestad, 1997; Judge, Jackson, Shaw, Scott, & Rich, 2007), its positive relationship with SAI may be due to an accurate reflection of open individuals' greater ability. Overall, the empirical evidence to date has shown that SAI is meaningfully associated with intelligence and personality traits at the phenotypic level; it is, however, unknown if these associations have also common genetic and environmental origins.

1.2. Genetic associations

Intelligence is considered to be one of the most heritable human traits, with studies typically yielding heritability estimates of 25% in young childhood, about 40% in middle childhood, and close to 80% in adulthood. Conversely, shared environmental influences impact IQ in early and middle childhood, but have often been reported to become negligible in later life (Plomin, DeFries, McClearn, & McGuffin, 2001). Two previous studies investigated genetic and environmental influences on self-perceived ability in sub-samples of the Twin's Early Development Study (TEDS). Spinath, Spinath, and Plomin (2008) reported genetic influences of 40% and non-shared environmental effects of 60% accounting for the variance in self-perceived abilities of 4464 children aged 9 years. In line with this, Greven, Harlaar, Kovas, Chamorro-Premuzic, and Plomin (2009) reported a heritability of 51% of self-perceived ability, whereas the common environment accounted for only 2%, in 3785 twin pairs assessed at age 7, 9 and 10 years. These results may seem counterintuitive, because self-estimates of abilities were traditionally thought to be largely shaped by parental beliefs, expectations, and attitudes (e. g. Bandura, 1995; Eccles et al., 1983).

In the same study, Greven et al. (2009) also examined influences on the phenotypic associations of intelligence, self-perceived ability and achievement, and concluded they could be primarily attributed to genetic factors. A common set of genes affected all three constructs, not only when assessed contemporaneously, but also when they were measured at different ages (Greven et al., 2009). Furthermore, genetic factors associated with intelligence accounted for a small proportion (15%) of the genetic variance in self-perceived intelligence but there was little evidence for a similar environmental link. That is, self-perceived ability is on the one hand independent of shared environmental influences, and on the other, shares some of its genetic – but none of its unique environmental – factors with intelligence. Based on these results, we might speculate if self-estimates of ability also share common genetic factors with their phenotypically associated personality traits.

Heritability estimates for personality traits are typically lower than those of intelligence with values ranging from 20 to 50% across samples and ages (Plomin et al., 2001). Probably because of a lack of correlations between IQ and personality at the phenotypic level, only few previous studies have examined the genetic basis of intelligence–personality associations (i.e. Luciano, Wainwright, Wright, & Martin, 2006; Wainwright, Wright, Luciano, Geffen, & Martin, 2008). The results suggested that associations between Conscientiousness and intelligence, which are typically close to zero (e.g. Ackerman & Heggestad, 1997), stemmed primarily from a common genetic factor (Luciano et al., 2006). A subsequent study of the same sample focused on the genetic basis of the intelligence–Openness association. A general genetic factor with substantial loadings from intelligence and two Openness facets supported that their phenotypic association is largely due to genetic factors (Wainwright et al., 2008). To date, no study has examined the genetic and environmental influences on associations between SAI and personality traits.

1.3. This study

In the current study, we aim to (1) replicate previous estimates of heritability for self-perceived ability in a sample slightly more matured than those examined previously (Greven et al., 2009; Spinath et al., 2008). Even though SAI