The incremental validity of intellectual curiosity and confidence for predicting academic performance in advanced tertiary students

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ABSTRACT

Intellectual curiosity is a topic of research interest and often predicts academic performance (AP). However, evidence for its incremental validity, which the present study aimed to assess, is mixed. Participants were 216 (52 males, 151 females, 13 not reported) third-year psychology students (age $M = 23.0$ yrs) who completed tests of fluid and crystallised intelligence, five-factor model (FFM) personality, intellectual curiosity, and confidence. AP was obtained from university transcripts. No incremental validity above intelligence and FFM personality was found for measures of curiosity or confidence. In all analyses, Conscientiousness was the most substantial predictor of AP. Future research may focus on the conditions in which curiosity or confidence predict AP.

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1. Introduction

The relationship between intelligence and curiosity has long been a topic of research, generating theories relating to different stages of human development. We survey these approaches, before addressing curiosity and other constructs as predictors of academic performance (AP).

1.1. Curiosity through the years

Berlyne (1950) viewed curiosity as an exploratory drive in animals and humans, excited by novel stimuli. He distinguished between curiosity excited by sensory experience (perceptual curiosity) and curiosity excited by knowledge and understanding (epistemic curiosity; Berlyne, 1954)—also called intellectual curiosity (IC; von Stumm, Hell, & Chamorro-Premuzic, 2011).

For infants, Fagan (1970) developed the concept of 'preference for novelty', suggesting that infants who give more attention to novel stimuli demonstrate more effective information processing—a basis for the emergence of intelligence (Fagan, 2000). This method predicts later IQ and AP (Fagan, Holland, & Wheeler, 2007), and demonstrates

continuity for intelligence through life. However, this relationship between intelligence and curiosity for infants should not be assumed to hold in later years.

Based on research with adolescents, Cattell (1963) strengthened his theory of fluid (Gf) and crystallised (Gc) intelligence, where Gf is genetically-determined abstract reasoning ability, and Gc is acquired knowledge. He explained their substantial correlation by his 'investment theory' that Gf was 'invested' in Gc over time. He also posited the importance of 'investment traits', such as interest and curiosity, that determined the strength of this investment (Cattell, 1963, 1987). Cattell proposed that the school curriculum provided the basis for Gc as a broad factor, and that the relationship between Gf and Gc would weaken in the years following compulsory education.

More recently, Ackerman (1996) developed his PPIK (process, personality, interests, knowledge) theory of adult intelligence. Extending Cattell's theory, PPIK retains the idea that Gf (process) is invested in Gc (knowledge), and formally incorporates the place of interest and personality variables in this process. Goff and Ackerman (1992) developed the Typical Intellectual Engagement (TIE) scale as a measure of IC, which has been used in subsequent research. Thus, the proposed relationship between intelligence and curiosity becomes more complex with age.

Additionally, two other measures of IC are of special interest: Need for Cognition (NFC; Cacioppo & Petty, 1982) and Epistemic Curiosity (EC; Litman, 2008). Although TIE, NFC and EC originated in separate research contexts, their strong intercorrelations and lack of discriminant

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validity suggest that they might be used interchangeably (Mussel, 2010; Woo, Harms, & Kuncel, 2007). NFC describes a tendency to enjoy cognitively stimulating activities or (negatively) the tendency to avoid thinking (Cacioppo, Petty, Feinstein, & Jarvis, 1996). EC is subdivided into 'interest' (EC-I) and 'deprivation' (EC-D) factors, where EC-I is similar to TIE and NFC, and EC-D relates to discomfort arising from perceived lack of information (Litman, 2008). Powell, Nettelbeck, and Burns (2016) conducted an exploratory factor analysis across TIE, NFC and EC scale items, and concluded that EC-D is unique to the EC scale. Because its items measure tenaciousness in curiosity (e.g. 'I work like a fiend at problems that I feel must be solved'), it merits investigation as a predictor of AP. The incremental validity of IC will be addressed below.

Another potential 'investment trait' is confidence (Stankov, Lee, Luo, & Hogan, 2012). Confidence can be measured as a dimension of personality or 'online', where, after answering a problem, participants are asked: 'How confident are you that your answer is correct?' (Burns, Burns, & Ward, 2016). Online confidence is a robust general trait distinct from Gf and Gc (Kleitman & Stankov, 2007) that predicts AP better than self-efficacy, self-concept, and anxiety (Stankov et al., 2012). Because of these qualities, confidence also warrants investigation as an 'investment trait' alongside IC, and as a predictor of AP.

1.2. Predictors of AP

We turn now to research on variables that predict AP. General intelligence is the pre-eminent predictor of AP, with reported correlations up to $r = 0.81$ (Deary, Strand, Smith, & Fernandes, 2007), although other studies have reported around $r = 0.5$ (Laidra, Pullmann, & Allik, 2007). Regarding personality, several meta-analyses have reviewed five-factor model (FFM; Costa & McCrae, 1992) variables as predictors of AP. Poropat (2009) concluded that Conscientiousness is a major predictor, and reported that Agreeableness and Openness are more modest predictors. For post-secondary students, Schuler, Hirn, Hell, and Trapmann (2007) reported that only Conscientiousness predicted grades consistently. Because intelligence and Conscientiousness tend to negligible (Poropat, 2009) or small negative (Moutafi, Furnham, & Crump, 2006) correlations, together they predict substantial variance in AP. Moreover, von Stumm et al. (2011) reported a meta-analysis in which IC and Conscientiousness together predicted as much variance in AP as did intelligence, concluding that IC is the 'third pillar' of academic performance alongside intelligence and Conscientiousness.

However, although these studies suggest that intelligence and personality measures may account for roughly 50% of the variance in AP, this leaves much variance unexplained. Moreover, if variables such as IC and confidence can be modified through intervention, establishing their ability to predict AP provides a basis for improving academic outcomes.

1.3. The incremental validity of IC

Current evidence for the incremental validity of IC is inconsistent, and may depend on which measure of IC is used. Because TIE has been used in several recent studies we will primarily discuss this measure. Several studies have reported incremental validity for TIE. Furnham, Monsen, and Ahmetoglu (2009) reported modest incremental validity (about 2–3%) for TIE scores above measures of intelligence and general knowledge for AP in British schoolchildren. Chamorro-Premuzic, Furnham, and Ackerman (2006) reported more substantial incremental validity (about 3–9% depending on assessment method) for TIE above intelligence and FFM variables in predicting AP in university psychology students. Finally, the meta-analytic study of von Stumm et al. (2011) concluded that IC is the 'third pillar' of AP.

However, two recent studies found little evidence of incremental validity. Powell and Nettelbeck (2014) reported that TIE predicted limited incremental variance beyond intelligence and Conscientiousness (about 1.8%) for university entrance scores, while other IC measures (including

NFC and EC) possessed no incremental validity. TIE may overlap more substantially with Gc than do other IC measures because it measures reading habits (Mussel, 2010), and thus it may be Gc—rather than IC per se—that makes TIE a useful, additional predictor of academic success (Powell & Nettelbeck, 2014). Moreover, Schroeders, Schipolowski, and Böhme (2015) reported only limited incremental variance for TIE in high school grades (0.5% for Mathematics, 1.3% for Physics, 1.5% for Biology, and 1.8% for Chemistry) after controlling for socioeconomic status, gender, migration background, Gf, and subject-specific interest. Together, these studies suggest that the incremental validity of TIE may be limited, and may be more substantial for some subject domains than others. The finding that different measures of IC show different patterns of incremental validity raises the question of whether TIE is a 'pure' measure of IC, and thus whether the incremental validity of IC has been established clearly.

1.4. The present study

Chamorro-Premuzic et al. (2006) and von Stumm et al. (2011) measured only general intelligence (g), while Powell and Nettelbeck (2014) measured only Gf, and therefore these studies did not assess Gf and Gc as distinct contributors when predicting AP. Moreover, although Stankov et al. (2012) compared confidence to other measures of self-belief, they did not control for intelligence or personality. These limitations suggest a study that measures intelligence, Conscientiousness, IC and confidence as predictors of AP.

Senior year undergraduate students provide a strong test of the predictive power of personality variables: they have a restricted range for intelligence, potentially allowing personality variables more scope to predict AP (cf. Lievens, Ones, & Dilchert, 2009). Despite mixed evidence, we anticipated small incremental validity for IC. The present study included TIE, NFC, and EC, measures of Gf and Gc, all FFM variables, and confidence. Hypotheses tested were:

(1) TIE predicts variance in AP after controlling for Gf, Gc, and FFM personality.
(2) EC-D predicts variance in AP after controlling for Gf, Gc, and FFM personality.
(3) Confidence predicts variance in AP after controlling for Gf, Gc, and FFM personality.

2. Method

2.1. Participants

Data were obtained from 219 third-year psychology students at a large Australian university who participated to fulfill a course practicum requirement. Students could withhold their data from analysis ($n = 3$), leaving 216 responses. Age ($M = 23.0$, $SD = 6.20$, range 19–62 yrs) and sex (52 males, 151 females, 13 not reported) were reported by 203 students. Tests were administered both in-class and online using SurveyMonkey. Because SurveyMonkey allows participants to complete surveys across multiple occasions, the M and SD of completion times are affected by several outliers. The median completion time was about 54.5 min, and about 2/3 of participants took between 30 and 90 min to complete the online component. Because data were missing in each administration, Ns differed by variable.

Scores below 3 for Advanced Progressive Matrices—Short Form (APM–SF) and Cattell's Assessment Battery—Inductive Reasoning (CAB–I) were considered insincere attempts ($n = 18$ and 13, respectively) and excluded. Scores of AP were retained only for students averaging ≥75% subject load across two years ($n = 146$) to allow only robust estimates of academic performance in the analyses. Students were informed only that the practical would explore individual differences in intellectual curiosity and AP.