



Past and future academic experiences are related with present scholastic achievement when intelligence is controlled



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ABSTRACT

Here the simultaneous relationships among cognitive ability (CA), past academic failure (PAF), future academic aspirations (FAA), and present scholastic achievement (PSA) were investigated. For addressing these rarely considered relations, two independent representative samples comprising 2796 students were analyzed; the first sample (young adolescents) included 1695 students from the third cycle of elementary school, whereas the second sample (old adolescents) comprised 1101 students from secondary school. SEM (structural equation model) analyses were computed and the main findings revealed that (1) CA, PAF, and FAA predict PSA, (2) CA is the best predictor of PSA, and (3) excluding PAF and FAA from the final SEM model produces a substantial reduction in the achieved predictive validity, especially for Language.

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1. Introduction

Understanding the causes underlying the observed widespread differences in scholastic achievement is a basic goal of scientific research, and it is also relevant for society (Chen & Kaplan, 2003; Haveman & Smeeding, 2006; Heaven & Ciarrochi, 2012; Kao & Thompson, 2003; Lee, Hill, & Hawkins, 2012; Phillipson & Phillipson, 2012; Porter, 2002; Wilson, 2001). Pioneering research frameworks have nominated large sets of cognitive and non-cognitive relevant factors (Webb, 1915). In this regard, Harris (1940) and Cattell (1965) highlighted three basic domains: (i) cognitive ability, (ii) effort (drive or degree of motivation), and (iii) personal, economic, social, and academic circumstances.

Cognitive ability is a well established predictor of scholastic achievement (Colom & Flores-Mendoza, 2007; Deary, Strand, Smith, & Fernandes, 2007; Jensen, 1998a; Laidra, Pillmann, & Allik, 2007; Neisser et al., 1996; Primi, Ferrão, & Almeida, 2010) with correlations ranging from .30 to .70 (Chamorro-Premuzic & Furnham, 2005; Deary et al., 2007; Jensen, 1998a,b; Kuncel, Hezlett, & Ones, 2004; Kyttälä & Lehto, 2008; Rosander, Bäckström, & Stenberg, 2011; Taub, Keith, Floyd, & McGrew, 2008), but non-cognitive factors also play a role (Bratko, Chamorro-Premuzic, & Saks, 2006; Conard, 2006; Farsides & Woodfield, 2003; Freiburger, Steinmayr, & Spinath, 2012; Furnham & Chamorro-Premuzic, 2004; Furnham, Chamorro-Premuzic, & McDougall, 2003; Gilles & Bailleux, 2001; Kane & Brand, 2006; Kappe & van der Flier, 2012; Nofle & Robins, 2007; O'Connor & Paunonen, 2007; Poropat, 2009). However, evidence

regarding further factors such as past academic failure and future academic aspirations is hardly considered.

In this respect, Bandura (1986, 1997) suggested that academic aspirations (the desired scholar outcome or how much schooling is wanted) and expectations (the most likely scholar outcome pursued or how much schooling is expected) can be relevant predictors of present and future educational attainment and occupational status in adulthood (Beal & Crockett, 2010; Feliciano & Rumbaut, 2005; Kao & Thompson, 2003; MacLeod, 1995). It is generally accepted that a better previous academic background leads to better chances of success in present scholastic achievement. Recent research shows that educational aspirations are associated with actual achievement and are an important predictor of achievement in school and beyond (Rothon, Arephin, Klineberg, et al., 2011). Even after controlling for a number of variables, such as prior achievement, educational aspirations are still strongly related with students' achievement (Rothon et al., 2011).

Academic aspirations and expectations are not stable throughout life and can be shaped and influenced, positively and negatively, by a wide constellation of factors (e.g. gender, age, ethnicity, sexual orientation, disability, socioeconomic status, religion, and other external factors such as peers, parents and teachers; e.g. Black, 2002; Cheng & Starks, 2002; Danziger & Eden, 2007; Goldstein, Davis-Keen, & Eccles, 2005; Mau & Bikos, 2000; Patton & Creed, 2007; Perry, Przybysz, & Al-Sheikh, 2009; Ryan, 2000). Further, these academic aspirations and expectations are particularly prone to changes over the course of adolescence (Beal & Crockett, 2010; Cooper, 2009; Eccles, Barber, Stone, & Hunt, 2003; Fredricks & Eccles, 2002). Cognitions about the future (e.g. school completion) take place during adolescence and become increasingly refined, more realistic, based on interests, perceived abilities, individual characteristics, and available opportunities (Crockett & Bingham, 2000; Eccles

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et al., 2003; Erikson, 1968; Nurmi, 2004). Adolescents' thoughts about their future might be important because they could influence outcomes such as choices, decisions, and activities, that may affect subsequent accomplishments and achievements (Beal & Crockett, 2010; Little, 2007; Nurmi, 2004).

Moreover, both cognitive and non-cognitive factors contribute to the prediction of scholastic achievement with greater or smaller intensity depending on the considered educational stage (e.g., O'Conner & Paunonen, 2007). Thus, for instance, cognitive ability is usually less related with scholastic achievement at higher educational levels (Almeida, Guisande, Primi, & Lemos, 2008; Chamorro-Premuzic & Furnham, 2005; Laidra et al., 2007; Lemos et al., 2010), which can be explained by a number of reasons. The first is related to the restriction of ability range (Almeida et al., 2008; Boekaerts, 1995) meaning that students in higher levels of schooling are more alike regarding their general cognitive ability. A plausible argument to explain this homogeneity is that students with lower cognitive abilities choose alternative educational curricula usually not included in the regular samples of high school students, or contribute to early dropout. Another argument follows the "law of diminishing returns". Originally proposed by Charles Spearman (1927), who reported that the average correlation between 12 cognitive ability tests was .466 in 78 normal children, and .782 in 22 "defective" children, this law (Spearman's Law of Diminishing Returns, SLDR) predicts that the *g* factor will account for a smaller proportion of individual differences in cognitive test scores at higher levels. The decreasing prediction of *g* at high educational levels may be due to smaller correlations among abilities in the more intelligent. These results were replicated elsewhere in a variety of children and adult samples (Deary & Pagliari, 1991; Detterman & Daniel, 1989; Tucker-Drob, 2009, but see Abad, Colom, Juan-Espinosa, & García, 2003).

Secondly, the decreasing correlation between cognitive ability and scholastic achievement at higher educational levels can also be explained by the *Gf-Gc* investment theory (Cattell, 1971). This theory suggests a diminishing relevance of fluid intelligence (*Gf*) due to the emergence and development of crystallized intelligence (*Gc*), more involved with consolidated knowledge obtained by education, experience and interests throughout adolescence. The elementary school learning inputs can be understood as basic acquisitions, less centered in content than in form, strongly associated with the exercise of basic processes in perception, memory, and reasoning, and easily confounded with fluid intelligence (*Gf*). In learning inputs and scholastic achievement starting in adolescence, considering a curriculum which grows exponentially both in amplitude and complexity, knowledge and experience are requested to a greater extent – crystallized intelligence (*Gc*), or specific skills are predominant. Understanding *Gf* more like "inductive reasoning" and *Gc* as "acculturation knowledge" (Horn & Noll, 1997) fits this explanation that illustrates the progressive importance of knowledge, contents and domains of cognitive problems (Ackerman, 1996; Beauducel, Brocke, & Liepmann, 2001; Cattell, 1987; Gustafsson, 1984; Guttman & Levy, 1991; Schweizer & Koch, 2001).

A third explanation is concerned with the increased contribution of further psychological factors associated with the learning process across school levels, such as educational aspirations and expectations, students' beliefs, motivation, study habits, students' approaches to learning, or vocational choices (Chamorro-Premuzic & Arteché, 2008; Eccles et al., 2003; Entwistle, Tait, & McCune, 2000; Fredricks & Eccles, 2002; Freiburger et al., 2012; O'Conner & Paunonen, 2007; Rosander & Bäckström, 2012; Steinmayr & Spinath, 2009).

It is noteworthy that previous research has often neglected the analysis of the relation between cognitive ability and academic achievement taking into account variables such as past academic failure and future academic aspirations. For filling this gap, the present study comprehensively investigates the relationships among cognitive ability, past academic failure, future academic aspirations, and present scholastic achievement analyzing representative samples of students. To study the interplay of cognitive ability, past academic failure, future academic

aspirations and scholastic achievement, two main models were tested: one that posits the exclusive relevance or direct effect of *g*, the named "only-*g*" model, and another model holding the relevance of further cognitive and other variables besides *g*, the named "non-only-*g*" model. Therefore, the present study tests if these two models are both suitable in predicting scholastic achievement on Language and Math, and, in particular, if both models have good fit indexes at the beginning and at the end of adolescence (young and old adolescents' samples, respectively). The potential contribution of specific cognitive skills is also addressed because, as noted above, they may differentially contribute to the prediction of different academic subjects (Bull & Johnston, 1997; Bull, Johnston, & Roy, 1999; Campos, Almeida, Ferreira, Martinez, & Ramalho, 2013; Geary, Hamson, & Hoard, 2000; Henry & MacLean, 2003; Kytälä & Lehto, 2008; Rothstein, Paunonen, Rush, & King, 1994).

2. Method

2.1. Participants

Two independent samples comprising 2796 students were considered. The first sample included 1695 students from the third cycle of elementary school (young adolescents; mean age = 13.5, *SD* = .97, range from 12 to 15 years) and the second sample comprised 1101 students from secondary school (old adolescents; mean age = 16.8, *SD* = .82, range from 16 to 19 years). All participants were involved in a larger study for the standardization of the Reasoning Test Battery (RTB; Almeida & Lemos, 2007) and answered some questions about past academic failure, future academic aspirations, and academic achievement. The samples were obtained randomly and state schools were selected considering previous stratification by regions in the country, school grade and gender within the class group at the school level. According to the annual school census of the Department of Assessment and Foresight and Planning – Ministry of Education – samples gather 6% of the Portuguese student population in the considered school levels.

The school system in Portugal considers three cycles in elementary school and one cycle in secondary school. The present study takes students from the 3rd cycle of elementary school, equivalent to junior high school in other countries (7th–9th grades), and secondary school (10th–12th grades), when students choose from among several curricular options in order to follow different graduation areas in higher education or professional specialization. The first school level corresponds to the first sample mentioned above, whereas the second level matches the second sample.

2.2. Measures

Intelligence was assessed through the Reasoning Tests Battery (RTB). The young adolescents performed the version designed for the first level (3rd cycle of elementary school) and the old adolescents performed the version designed for the second level (senior high school battery). In both cases, the RTB consists of five reasoning time-limited subtests: abstract reasoning (AR, 25 figural analogies and 5 min of administration time), numerical reasoning (NR, 20 numerical series and 10 min of administration time), verbal reasoning (VR, 25 verbal analogies and 4 min of administration time), mechanical reasoning (MR, 25 mechanical problem-solving items and 8 min of administration time), and spatial reasoning (SR, 20 spatial orientation and cube rotation series and 9 min of administration time). Fig. 1 shows examples of items from these subtests.

Reliability indices were computed by test–retest and internal consistency methods. Obtained indices ranged from .63 (mechanical reasoning subtest) to .84 (numerical reasoning subtest). Factor analysis computed from different samples confirmed a single factor explaining between 50 and 60% of the variance (Almeida & Lemos, 2007). Previous confirmatory factor analysis confirms this general factor of intelligence (*g*) that predicts the five measures comprised in the battery in both

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