



# The relative effects of socio-economic, demographic, non-cognitive and cognitive influences on student achievement in Australia

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## ABSTRACT

This paper examines socio-economic, demographic, non-cognitive and cognitive influences on early childhood cognitive ability and subsequent student achievement at school analyzing Australian longitudinal data. The clearly dominant influences on achievement are early childhood cognitive ability and prior achievement. Socio-economic status (which includes accurate measures of family income) has only moderate relationships with early childhood cognitive ability and student achievement. Its effects on student achievement are small when taking into account early childhood cognitive ability and especially prior achievement. This is also the case for family size, family type and to some extent, Indigenous status, but not for gender and language background. Of the non-cognitive attributes examined only 'persistence' has a moderate impact on student achievement. Fixed effects analyses show very small and statistically insignificant effects for family income and father's occupational status, but consistent, albeit small, effects for persistence. This study demonstrates that, contrary to popular belief, student achievement is not strongly linked to family income or socio-economic status.

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## 1. Introduction

There are two very distinct approaches to the study of student performance in standardized assessments. The most prominent approach emphasizes the importance socio-economic status or social class, and other ascribed characteristics, such as gender, race and ethnicity. Schools and their resources, and teachers are further along the causal chain. Reports on student achievement often reflect this approach with separate chapters on socio-economic status, gender, ethnicity (and race depending on the context), and schools (e.g. OECD, 2007, 2010, 2013). Socio-economic status is considered the primary influence since racial, ethnic, family and school differences in student performance are understood, at least partially, as explained by socio-economic status (Chiu & Xihua, 2008; Dronkers & Róbert, 2008; Marks, 2005, 2006a, 2006b). This is the implicit perspective of policymakers where poor student performance is understood as due to socio-economic and demographic factors, so the appropriate policy responses is to allocate greater resources to families belonging to disadvantaged social groups or the schools their children attend.

The alternative perspective emphasizes the role of cognitive ability in student achievement and other educational outcomes (Marks, 2014; Spinath, Spinath, Harlaar, & Plomin, 2006; Weber, Lu, Shi, & Spinath, 2013). In this perspective, students' cognitive ability explains

the high correlations of student performance across subjects and within-subjects over the school-career. The cognitive ability approach contends the student ability is the dominant influence on student performance. This is not to say that cognitive ability is the only explanatory variable for student performance. Prior competence in the subject area and non-cognitive attributes, such as motivation, are also involved (Kriegbaum, Jansen, & Spinath, 2015). Students need to be taught knowledge and skills in schools, by teachers with educational resources. This alternative approach is often unattractive to both researchers and policy makers since it implies little can be done to improve student performance or reduce socio-economic and other inequalities since cognitive ability is quite stable (Deary, Pattie, & Starr, 2013; Gow et al., 2011; Marks, 2014, pp. 55–56).

The majority of researchers in the field would probably concur with Ferguson's (1991, p. 471) statement "Social science theories suggest that educational outcomes such as grades and test scores are the products of innate ability, school inputs, and inputs from families and communities". However, there is little consensus of the relative magnitude of these influences. Often, it is assumed that socioeconomic status and social attributes are strongly associated with student achievement and that the influence of cognitive factors is not nearly as important and can be largely attributed to social background. Some research claims non-cognitive attributes are just as, or even more, important than cognitive ability for educational outcomes (e.g. Farkas, 2003).

The purpose of this paper is to examine the relative contribution of socio-economic, demographic, non-cognitive attributes and cognitive

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**Table 1**  
Univariate statistics for student NAPLAN performance.

| Variable                                 | Number of observations | Mean  | Standard deviation | Minimum | Maximum |
|------------------------------------------|------------------------|-------|--------------------|---------|---------|
| Who Am I (wave 1)                        | 4880                   | 64.0  | 8.1                | 29.9    | 96.9    |
| Peabody Picture Vocabulary Test (wave 1) | 4406                   | 64.2  | 6.2                | 28.2    | 84.8    |
| Peabody Picture Vocabulary Test (wave 2) | 4317                   | 73.8  | 5.1                | 46.4    | 91.6    |
| Matrix Reasoning Test (wave 2)           | 4413                   | 10.3  | 3.0                | 1.0     | 19.0    |
| Peabody Picture Vocabulary Test (wave 3) | 4273                   | 78.3  | 4.9                | 45.3    | 105.7   |
| Matrix Reasoning Test (wave 3)           | 4270                   | 10.7  | 3.1                | 1.0     | 19.0    |
| Cognitive ability (combined) wave 1      | 4383                   | 0.0   | 1.0                | −4.5    | 4.1     |
| Cognitive ability (combined) wave 2      | 4312                   | 0.0   | 1.0                | −4.7    | 3.6     |
| Cognitive ability (combined) wave 3      | 4267                   | 0.0   | 1.0                | −6.0    | 4.4     |
| Cognitive ability (combined) waves 1 & 2 | 4832                   | 0.0   | 1.0                | −5.1    | 3.5     |
| Cognitive ability (combined) waves 1–3   | 4871                   | 0.0   | 1.0                | −5.7    | 4.0     |
| Year 3 numeracy                          | 2987                   | 420.3 | 73.9               | 180.0   | 666.0   |
| Year 3 reading                           | 2986                   | 426.4 | 85.3               | 5.0     | 685.0   |
| Year 3 writing                           | 2993                   | 428.1 | 71.1               | 89.0    | 685.0   |
| Year 3 spelling                          | 2993                   | 418.4 | 77.3               | 180.0   | 669.0   |
| Year 3 grammar                           | 2989                   | 431.6 | 87.5               | 62.0    | 677.4   |
| Year 5 numeracy                          | 3907                   | 501.9 | 72.6               | 223.9   | 830.4   |
| Year 5 reading                           | 3928                   | 506.7 | 81.0               | 90.0    | 842.0   |
| Year 5 writing                           | 3916                   | 494.3 | 70.4               | 89.0    | 778.0   |
| Year 5 spelling                          | 3922                   | 494.4 | 69.7               | 296.6   | 672.0   |
| Year 5 grammar                           | 3922                   | 515.7 | 85.5               | 94.4    | 839.0   |
| Year 7 numeracy                          | 3707                   | 555.5 | 74.0               | 343.0   | 922.8   |
| Year 7 reading                           | 3721                   | 558.2 | 70.5               | 261.4   | 785.3   |
| Year 7 writing                           | 3718                   | 533.8 | 76.2               | 94.5    | 807.2   |
| Year 7 spelling                          | 3724                   | 550.1 | 69.8               | 351.0   | 751.9   |
| Year 7 grammar                           | 3724                   | 558.0 | 78.3               | 193.3   | 784.5   |
| Year 9 numeracy                          | 2839                   | 605.3 | 74.0               | 355.7   | 920.0   |
| Year 9 reading                           | 2855                   | 600.0 | 68.4               | 195.6   | 890.6   |
| Year 9 writing                           | 2852                   | 569.5 | 88.9               | 94.5    | 807.2   |
| Year 9 spelling                          | 2858                   | 594.9 | 70.0               | 316.5   | 802.3   |
| Year 9 grammar                           | 2858                   | 594.3 | 79.7               | 179.3   | 894.0   |

factors on student performance in five domains in the Australian National Assessment Program—Literacy and Numeracy (NAPLAN) across 6 years.<sup>1</sup>

## 2. Materials and methods

### 2.1. Data

The data analyzed are from the kindergarten cohort of the Longitudinal Study of Australian Children (for an overview see [Sanson et al., 2002](#)). The sample frame comprises the Medicare<sup>2</sup> records of in-scope children born between March 1999 and February 2000. The sample was selected through Multi-Stage Cluster Sampling ([Soloff, Lawrence, & Johnstone, 2005](#)). The first wave of data collection occurred when the children were aged 4 to 5 years old in 2004. Data collection for the second, third, fourth and fifth waves occurred in 2006 (when the children aged 6 to 7), 2008 (aged 8 to 9), 2010 (aged 10 to 11), 2012 (aged 12 to 13) and 2014 (aged 14–15). The number of successful face-to-face interviews has declined from 4983 in wave 1 to 3537 in wave 6 ([AIFS, 2015](#), pp. 14–16).

The LSAC data for waves 1 to 6 was merged with student achievement data from NAPLAN (detailed below). Data from the Year 3 NAPLAN test was collected in May 2008 or May 2009. Year 5, 7 and 9 NAPLAN data were collected 2, 4 and 6 years later ([Daraganova & Siphthorp, 2013](#)).

### 2.2. Measures

**Table 1** presents the summary statistics for cognitive and NAPLAN performance measures. **Table 2** presents summary statistics for the measures of socio-economic status, demographic variables, hours of preschool attendance and non-cognitive attributes.

#### 2.2.1. NAPLAN measures

Since 2008, the performance of Australian students across a variety of subject areas (or domains) has been measured by NAPLAN. NAPLAN tests are conducted on almost all students across Australia in Years 3, 5, 7 and 9. All students in the same year level are assessed on the same test items in the assessment domains of numeracy, reading, writing, spelling and grammar. The spelling and grammar domains are assessed within the same ‘language conventions’ test. Students’ scores (called scaled scores) in each of the five domains across the four year levels are standardized to a mean of 500 and a standard deviation of 100 and range from zero to 1000.<sup>3</sup>

#### 2.2.2. Family income

For each wave, family income was derived from the weekly incomes from both parents from all sources. Major efforts were made to construct, as far as possible, accurate family income measures ([Mullan & Redmond, 2011](#)). Family income was first adjusted to 2014 dollars through the annual Consumer Price Index (CPI) and then logged. For the bivariate analyses of Year 9 achievement, a measure of permanent income was calculated by averaging the CPI-adjusted family income measures in waves 1 to 6 and then taking the log of the average.

#### 2.2.3. Socio-economic status

For each wave, the measures of socio-economic status (SES) comprise logged family income, father’s and mother’s years of education and father’s and mother’s occupational status. Family income is described above. For each parent, education level attained (Year level and post-school qualifications) was converted into years of education and their occupation was converted to the appropriate measure of occupational status according to the census schema used to code occupations ([Jones & McMillan, 2001](#); [McMillan, Beavis, & Jones, 2009](#)). To minimize missing data, if one or more components of SES were missing

<sup>1</sup> Due to the nature of the sample, it is not possible to examine the effects of schools.

<sup>2</sup> Medicare is the national medical insurance scheme covering all citizens.

<sup>3</sup> Further details on NAPLAN and the NAPLAN achievement measures are available <http://www.nap.edu.au/naplan/naplan.html>

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