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The Effects on Schooling Outcomes of Early Developmental Vulnerabilities in Children

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Further information on the CATS study can be found at https://cats.mcri.edu.au/ or on Facebook https://www.facebook.com/CATS.Study.12

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Executive Summary

Aim and outline of the report

In Australia and many other countries, the provision of the healthiest possible start in life for all children has been a priority for government. Evidence to support the importance of the early years for future development has accumulated over the past two decades [1]. Patterns of childhood development predict health, wellbeing, learning and behaviour and lay a foundation for children to grow up with the skills to succeed, bringing benefits for them and the community as a whole [2].

The Australian Early Development Census (AEDC) is one major investment within the national agenda for early childhood development. Established in 2009, the AEDC is a triannual assessment of the physical, cognitive, social and emotional development of every child starting formal full-time education in Australia [3]. It provides information to communities, governments and schools to support their planning and service provision. It also allows identification of groups of students who are developmentally vulnerable (DV) when entering the education system.

In contrast to a policy and research emphasis on the first 5 years of life over recent decades, much less attention has been given to later childhood development [4]. Given important lifelong intellectual, social, emotional and behavioural skills are developed at all stages of education there is a pressing need to understand the significance of being identified as developmentally vulnerable. Are these children at higher risk for school disengagement? Do they lag behind their peers in their learning? Are they more likely to experience poorer wellbeing and peer relationship quality?

Equally important is the development of students *not* identified as DV at the start of school. How commonly do education problems emerge amongst students with no detectable early vulnerabilities? How do problems emerging later in development during the middle years (defined here as 8 to 14 years of age, or Years 3-7 of schooling) affect schooling outcomes? This report seeks to answer some of these questions.

This report presents findings from a linkage study involving the 2009 AEDC and CATS (Childhood to Adolescence Transition Study) datasets. CATS is an ongoing longitudinal study of health, wellbeing and educational achievement through late childhood and early adolescence. The sample comprises over 1,200 students and their parents drawn from Year 3 in 2012 from randomly selected schools across metropolitan Melbourne. We obtained information annually from students, parents and teachers on students' mental health and wellbeing, peer and family relationships, school engagement and the primary to secondary school transition. Student academic achievement data was obtained from linked NAPLAN scores at Years 3, 5 and 7. Linkage with the AEDC provided a unique opportunity to study the relationships between developmental vulnerabilities in children at entry to primary school (2009; 5-6 years of age) and learning, wellbeing and social outcomes from Year 3 (2012: 8-9 years of age) through to the first year of secondary school (2016; 12-13 years of age).

A recent report [5] utilising longitudinal data from the metropolitan Melbourne CATS study showed that a significant minority of children in the middle years' experience mental health and wellbeing problems which profoundly affects school engagement and learning outcomes. The report found a rise in the prevalence of these problems in the later primary school years, most likely a result of extensive social, emotional and biological changes during this period. It also demonstrated the inter-relationships between wellbeing, engagement and learning supporting a conceptual

framework for quality education in which these characteristics are all inter-dependent and reinforcing over time (Figure 1: [5]).

Guided by the conceptual framework described in our previous report, the current report uses a linked longitudinal dataset of student development and academic achievement spanning the entire primary school years (from the first year of primary school; 5-6 years of age through to Year 7; 12-13 years of age) to address the following questions:

1. *What is the relationship between early developmental vulnerability on the AEDC and later learning, school engagement and wellbeing?*
2. *How might any relationship between early developmental vulnerability and learning at Year 7 be affected by wellbeing and school engagement across Years 3, 4 and 5?*

Academic achievement or learning success can be measured in several different ways, however, for the purposes of this report we followed the approach taken by Lamb et al in their report on Educational Opportunity in Australia 2015 [6] who established a performance threshold for Year 7 learning success that is half a NAPLAN band higher than the national minimum standard (NMS) [6]. The NMS is set by ACARA as the second lowest band, Band 5 in Year 7 [7] and is reached by the vast majority of students; in 2016 95.5% of Australian Year 7 students achieved the NMS for numeracy and 94.6% achieved the NMS for reading.

Key findings

Developmental vulnerability as a predictor of poor future outcomes

As a group, students who enter school with developmental vulnerabilities have higher rates of difficulties in education than those starting school on track. For most outcomes, these difficulties are present at Year 3 and are maintained up to Year 7.

- DV students, on average, have lower NAPLAN numeracy and reading scores in Years 3, 5 and 7. When NAPLAN scores are expressed in terms of Equivalent Years of Learning (EYL), the learning gap between developmentally vulnerable and not-vulnerable students increases over time; at Year 3 the DV group has a 1 year delay relative to their not-DV peers and this grows to over 2 years by Year 7.
- DV students are at higher risk of early school disengagement. In Year 4, over 17% of DV students are disengaged from school, over double the proportion of not-DV students (8%).
- DV students are more likely than their not-DV peers to experience poor wellbeing:
    - They are at increased risk of emotional problems in Years 3 to 5 (DV students are over two-times more likely to experience persistent emotional problems than their not-DV peers) but this risk does not continue into Years 6 and 7.
    - They are at increased risk of single episodes and persistent behaviour problems in Years 3 to 5 (DV students are over three-times more likely to have behaviour problems than their not-DV peers). The risk of behaviour problems remains substantially higher for DV students in Years 6 and 7.
    - They are more likely to report low subjective wellbeing in Years 3 to 5 (DV students are over two-times more likely to report persistent low wellbeing than their not-DV peers). The risk of low wellbeing remains substantially higher for DV students in Years 6 and 7.
- DV students are at almost double the risk of being persistently bullied across Years 3, 4 and 5. This risk appears to decrease across time: In Year 3, 38.1% DV students versus 29.0% not-

DV students were bullied and in Year 6, 16.7% DV students versus 14.9% not-DV students were bullied.

However, more than half of students with early developmental vulnerabilities do not experience educational delay at Year 7: 62.8 and 55.4% of students presenting with DV at school entry attain the numeracy and reading academic threshold respectively. A large majority of students starting school not-DV go on to attain the Year 7 numeracy and reading threshold (87.7% and 83.5% respectively).

Academic outcomes at Year 7

In fact, m**ost students with poor learning outcomes at Year 7 were not identified as developmentally vulnerable on school entry.** Two-thirds of students failing to meet the Year 7 performance threshold for numeracy and reading had not been identified as developmentally vulnerable on the AEDC in their first year of school.

Poor wellbeing, school disengagement, being bullied in mid-childhood together with emotional and behaviour problems predict poor Year 7 learning outcomes. This effect appears relatively independent of early DV.

Conclusions

The results from this report show that the strong relationship between middle years indicators and Year 7 learning outcomes is largely independent of DV status at school entry suggesting that problems in the middle years, whether emergent or not, are important risk factors for poor learning outcomes. The report also shows that a majority of those who enter school with developmental vulnerabilities do not fall into the categories of poor emotional wellbeing and poor educational attainment by Year 7. Nevertheless, those presenting with DV at school entry as a group are at higher risk than those who began school without these vulnerabilities, suggesting that the AEDC has some utility in identifying those at risk of poor later child development.
Education systems, schools and teachers also need to consider the needs of students who start school without any apparent vulnerabilities. The primary to secondary school transition is, for example, a time when problems often arise and should be promptly attended to. The indicators of academic progress, disengagement, wellbeing and peer relationships used in this report are examples of tools that could be used to identify and track the progress of students through mid-childhood.

Education systems, schools and teachers need to support those who enter school with developmental vulnerabilities. In our sample 17.7% of students began school with one or more developmental vulnerability. Each commencing primary school class can therefore be expected to have 4 to 5 students with at least one developmental vulnerability. Important approaches are likely to include: prevention of early school disengagement; promotion of social inclusion and supporting positive emotional development; and prevention of bullying.

This report is a first step towards understanding the relationships between early developmental vulnerabilities and later social, emotional and academic adjustment. Future research would usefully focus on the pathways taken by students as they move through the education system. Areas for enquiry might include:

- Examination of longer term social, emotional and education outcomes (including learning, engagement and wellbeing) for developmentally vulnerable children beyond Year 7.

- Extending current understandings of the predictors of social, emotional and educational outcomes for developmentally vulnerable children. This would include a better understanding of the extent to which experiences in mid-childhood within the school setting might mediate the relationship between early vulnerability and these outcomes in early adolescence.
- Children with poor social, emotional and educational adjustment and not identified as developmentally vulnerable should become a priority in further work. They constitute the majority of those who are failing academically at year 7 and have until now been largely outside of a policy focus.

The major policy and research emphasis on the first 5 years of life over recent decades stands in contrast to the relative neglect of later childhood and early adolescence. The findings from this report suggest that major modifiable determinants of educational success act across the mid-childhood years for all students and should become a greater focus in policy and research.

Glossary

Adolescence

Adolescence is the period of physical, cognitive, and social maturation between childhood and adulthood. Although there is variation in how societies and cultures define adolescence, its beginning is marked by the onset of puberty and its end is generally considered as the uptake of stable adult roles. The World Health Organization (WHO) defines an adolescent as any person between ages 10 and 19.

Australian Early Development Census

The Australian Early Development Census (AEDC) is a nationwide survey of child development conducted in a student's first year of full-time school. The AEDC collects data from school teachers for each child on five key areas: Physical health and wellbeing, social competence, emotional maturity, language and cognitive skills, and communication skills and general knowledge. It has been conducted every three years since 2009.

Australian Early Development Index

The Australian Early Development Census (AEDC) was formerly known as the Australian Early Development Index (AEDI). It became the AEDC on the 1st of July, 2014.

Behaviour problems

Behaviour problems refer to displays of behaviour that deviate from social norms and are socially disapproved from those of authority. Behaviour problems can be the symptomatic expression of emotional problems or interpersonal maladjustment and include attention-deficit hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), or conduct disorder (CD). Behaviour problems are sometimes described as externalising problems.

Bullying

Bullying is repeated verbal, physical, social or psychological aggressive behaviour by a person or group directed towards a less powerful person or group that is intended to cause harm, distress or fear. Bullying is sometimes referred to as peer victimisation.

Developmental vulnerability (DV)

Students are classified as developmentally vulnerable on each of the five AEDC domains as follows: for each domain, children receive a score between zero and ten, where zero is most developmentally vulnerable. Cut-offs to dichotomise this distribution into developmentally vulnerable and not developmentally vulnerable groups were established by the AEDC in 2009. The cut-offs were set such that the lowest 10 percent of participants in each domain in 2009 were classified as developmentally vulnerable. The binary AEDC variable, DV1, classifies students as vulnerable (developmentally vulnerable on 1 or more domains) or not vulnerable (not developmentally vulnerable on any of the 5 domains).

Early development index (EDI)

The EDI is the survey instrument used to assess child development in the AEDC. It was originally developed in Canada and has been adapted for the Australian context. It contains 96 items for teachers to complete across 5 developmental domains and has proven reliability and validity.

Emotional problems

Emotional problems refer to symptoms of anxiety and depression such as sadness, loneliness, worrying, feelings of worthlessness and anxiousness. Emotional problems are sometimes described as internalising problems.

Equivalent Year Level (EYL)

A metric developed by the Grattan Institute. The EYL corresponds to the NAPLAN Scale Score (NSS) the median (typical) student is expected to achieve.

Learning

Student learning encompasses the knowledge, skills, and abilities that students attain as a result of their involvement in education. Academic progress is a key component of this, but this concept also includes important life skills not directly measured by standardised tests such as resilience, self-efficacy, perseverance and social skills.

Learning progress

Improvements in knowledge, skills, and abilities that students attain over time as a result of their involvement in education.

Logistic Regression

Logistic regression is a method of statistical analysis used when the dependent variable is dichotomous (has two possible outcomes), and there are one or more independent variables that can determine these outcomes. Logistic regression aims to describe the relationship between a set of predictive variables (independent) and the extent to which they predict the binary outcomes (dependent variables).

Mental health problems

Mental health problems, sometimes referred to as mental illness or mental disorders, are a wide range of conditions that affect mood, thinking and behaviour. Many people will have symptoms of poor mental health from time to time but it becomes a problem (or disorder) when the symptoms are on-going and affect the ability to function.

Middle years

The middle years, in this report defined as 8 to 14 years of age, are a period of rapid physical, emotional and intellectual growth. This is also a period of transitions, for example the transition from childhood to adolescence, and from primary to secondary school.

NAPLAN

The National Assessment Program – Literacy and Numeracy (NAPLAN) is an annual test of all Australian students in Years 3, 5, 7 and 9. Testing covers four domains: reading, writing, language conventions (spelling, grammar and punctuation) and numeracy.

NAPLAN scale score (NSS)

The scale score is an estimate of student ability at a given point in time. For each NAPLAN domain, students in Years 3, 5, 7 and 9 are scored along the same scale that has a range of 0 to 1000.

Odds Ratio (OR)

An odds ratio (OR) is a measure of association between an exposure (e.g. emotional problems) and an outcome (e.g. school disengagement). The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. If the outcome is the same in both groups the ratio will be 1.

Peer support

Peer support refers to the functions performed for an individual by friends and classmates. It can include emotional support (demonstrations of love and caring, esteem and value, encouragement, and sympathy), instrumental support (provision of facts or advice that may help a person solve problems) and informational support (supplying behavioural or material assistance with practical tasks or problems).

Programme for International Student Assessment (PISA)

The Programme for International Student Assessment (PISA) is a triennial international survey conducted by the Organisation for Economic Co-operation and Development (OECD) which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. The last assessment in 2015 tested over half a million students, representing 28 million 15-year-olds in 72 countries and economies. Students were assessed in science, mathematics, reading, collaborative problem solving and financial literacy.

Puberty

Puberty is a universal experience in normal human development and marks the transition from childhood to adulthood. It is accompanied by physical growth, brain maturation and sexual maturation and results in reproductive capability. Puberty is a combination of physiological processes with the hormonal changes beginning several years before the physical changes. There are at least three hormonal events involved in puberty: adrenarche, gonadarche, and the growth spurt.

Quality education

Quality education fosters the social, emotional, mental, physical, and cognitive development of each child. It aims to develop the full potential of each and every student regardless of gender, race, ethnicity, socioeconomic status, or geographic location.

Risk ratio (RR)

Risk ratio (RR) represents the probability of an event occurring in one group, compared to the probability of the same event occurring in another group. A risk ratio of one means there is no difference between the two groups. If the risk ratio is greater than one, there is an increased probability of the event occurring. Likewise, if the risk ratio is less than one, there is a decreased probability of the event occurring.

School engagement/disengagement

School engagement refers to a student's' relationship with school, school staff, other students and learning. It includes behavioural, emotional and cognitive components; a highly engaged student will participate in academic and social activities, will have a sense of belonging or connection with school, and will be motivated in their learning. Engagement is measured on a continuum with the

lower part of the distribution considered to be disengaged. Disengagement is characterised by low attendance and participation, a lack of motivation for learning and low connection with teachers and school.

Socio-Economic Indexes for Areas (SEIFA)

Socio-Economic Indexes for Areas (SEIFA) is a metric developed by the Australian Bureau of Statistics (ABS) that ranks areas in Australia according to relative socio-economic advantage and disadvantage. It is based on information from the five-yearly Census. The census variables used include: Education, employment, occupation, housing and other indicators of advantage and disadvantage.

Social and emotional skills/social and emotional learning

Social and emotional learning is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.

Subjective wellbeing

Subjective wellbeing is the individual's rating of their own happiness and quality of life.

Wellbeing

Wellbeing is a broad and multi-faceted concept describing an aspiration for students to live a happy and fulfilling life. Wellbeing includes a student's subjective experience and their capabilities (psychological, cognitive, social and physical functioning). It is strongly influenced by objective circumstances such as physical environments and social relationships.

Years of (learning) progress (YOP)

A metric developed by the Grattan Institute. Years of progress (YOP) is the difference in years and months between Equivalent Years of Learning (EYLs) between two points in time for a given student.

Introduction

Background

There is general agreement that the provision of the healthiest possible start to life is a major priority for the Australian government, and one that has great community support and benefits for all. Over the past two decades in Australia the major focus of policy and public investment in child health has been on the first five years of life. Yet this concentration of policy and public investment has failed to translate into better health and improved social and educational outcomes for Australian children. One likely reason is that development continues beyond these very early years in which case it is essential public policy continue to invest in later childhood and adolescence when children are still growing and learning.

Despite increases in education expenditure over the past decade results from national and international tests, such as the National Assessment Program – Literacy and Numeracy (NAPLAN), Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) show that education outcomes of Australian children show little improvement and are even declining in the middle years [1, 8]. Grattan Institute (2016) analyses also showed that the learning gap for disadvantaged students triples between Years 3 and 9 [9]. International comparative data indicate that this is not the case in other countries with characteristics similar to Australia where improvements in such outcomes have been observed [10]. This suggests that there are unique factors in the Australian context requiring examination.

The policy focus on early investment in the first five years of life is well established and is supported by research evidence [2-4]. In contrast, the evidence to support ongoing investment in later childhood and adolescence is limited and policies have not been directed towards middle to late primary school, or the transition to secondary school. Longitudinal research is needed to track children as they pass through the education system and to examine the factors that might influence any change in academic achievement [5].

The Australian Early Development Census (AEDC) assesses development across five key domains of functioning in children's first full-time year of school. These domains are: physical health and wellbeing; social competence; emotional maturity; language and cognitive skills; communication skills and general knowledge. It provides a unique opportunity to identify groups of students who may be at risk of developmental problems and poor educational outcomes at school entry i.e. who are developmentally vulnerable. There is a pressing need to better understand what happens to these vulnerable students as they pass through the education system. It is important to understand what factors are predictive of better or worse education outcomes, and whether their learning, social and emotional needs are being met once in school. Furthermore, there is most likely a group of students with no developmental difficulties evident at school entry (i.e. have no developmental vulnerabilities on the AEDC) who develop problems academically, emotionally, behaviourally and socially later in school. Research is therefore needed to identify what factors may predict these problems.

This project will provide the Australian Government, as well as the wider policy and research community, with valuable evidence to fill a gap in our understanding of the factors driving outcomes of Melbourne metropolitan school children as they transition through the middle years. This project makes use of the globally unique Childhood to Adolescence Transition Study (CATS), which has been linked with the AEDC dataset, to examine these questions. In this respect, this

project linking CATS, AEDC and NAPLAN outcomes provides fundamental knowledge around the investments that should be made in later childhood to improve educational outcomes including school engagement, learning, and healthy social and emotional development.

Early childhood development

Evidence to support the importance of the early years (first five years of life) for future development has accumulated over the past two decades [1, 8, 10, 11]. A large body of research exists which has examined links between early school assessments of cognitive and social and emotional skills and early school outcomes. For example the Mitchell Institute's 2015 report, 'Educational Opportunity in Australia 2015: Who Succeeds and Who Misses Out', demonstrated that many of the children who enter school developmentally vulnerable fail to catch up, with around 10% remaining behind their peers throughout the middle years and in their later attempts to transition into further education or work [6]. A report by the Canadian Education Quality and Accountability Office found similarly poor outcomes for developmentally vulnerable children [12]. Children 'vulnerable' or 'at risk' in the first year of school were less likely to meet provincial standards in reading, writing and mathematics in Grade 3 than those who were not. An early meta-review of studies conducted between 1985 and 1998 found that individual differences in cognitive skills at the commencement of primary school predicted academic performance in the early school years. These findings have been replicated in more recent studies [13]. The continuity of cognitive (academic) skills continues beyond early primary school into the late primary [14] and secondary years, and possibly throughout life.

Whilst early school levels of cognitive skills are an important predictor of later school success it is clear that other aspects of a young child's development such as physical health, emotional wellbeing and social skills, play a critical role in success at school and later life [15]. Although early school levels of social and emotional skills appear less predictive of later academic outcomes than cognitive skills [13, 14, 16], they appear to be strongly related to other important educational outcomes such as engagement in school and motivation for learning, peer and teacher relationships and school adjustment [17]. Additionally, social and emotional skills show less stability than cognitive skills across this period suggesting they are more malleable to environmental influences.

The middle years

The middle years (which in this report are defined as 8-14 years of age, or Years 3-7 of schooling) are a time of major physical, social and educational change for children [18]. In this period children pass through puberty, with its associated changes to growth, secondary sex characteristics and brain development [19, 20] as well as making one of the most significant transitions in their educational lives, with the move from primary to secondary school [21]. This transition involves changes in relationships with peers and teachers, schoolwork, and the school environment. This is reflected in the marked changes in academic achievement, falling engagement with education and rising suspension rates that follow the move to secondary school. Despite this, there are currently no evidence-based, system-wide policies to support students in these middle years transition [22].

The middle years are a time when social and emotional skills develop rapidly. There is now broad agreement among educators, policy makers and the public that social and emotional skills, sometimes referred to as non-cognitive or 'soft' skills, are educational goals in themselves, [23] as well as important facilitators of academic achievement. Yet the middle years are also a time when emotional and behavioural problems commonly emerge. Fifty percent of mental health problems are evident by 14 years of age, with the symptoms of these disorders emerging in mid-late primary

school [24]. Emotional and behavioural problems have profound effects on school engagement and performance [5, 25]. It is estimated that individuals with mental health problems account for almost one half of all high school dropouts [26]. It is therefore important to identify the factors in early childhood that are predictive of healthy social and emotional development during the middle years.

The middle years present exciting opportunities for investment from the education sector. The focus on the early years as key determinants of health, education and social outcomes has created an impression that the middle years are simply a phase during which early vulnerabilities are compounded and expressed as poor outcomes. However, the dynamic nature of development in the middle years may see a change in the trajectories of developmentally vulnerable children as well as seeing the emergence of new vulnerabilities that lead to loss of potential in adolescence and beyond.

The Australian Early Development Census

The Australian Early Development Census (AEDC) is a population-based assessment of early childhood development undertaken tri-annually in Australia since 2009 [2]. The AEDC collects data from teachers for all students in their first year of primary school using the Australian version of the Early Development Instrument (EDI). The EDI was developed in Ontario, Canada and adapted for the Australian context. It was designed to measure 'school readiness' as marked by child development in five specific domains relevant to meeting the demands of school-based learning [27]. Assessments of the EDI have demonstrated excellent validity and reliability [27] and it has been used in over twenty countries worldwide since it was developed in the 1990s [28].

The AEDC was adapted from the EDI after extensive piloting from 2002 until 2008 [11]. Piloting demonstrated the measure had good psychometric properties when administered in the broader Australian population, in the Aboriginal and Torres Strait Islander (ATSI) populations and in children from a non-English speaking background [29-32]. A qualitative study conducted across three iterative implementation cycles confirmed the feasibility and usefulness of community implementation of the AEDC and its findings [33].

In 2007, the AEDC was endorsed by the Council of Australian Governments (COAG) as a national progress measure of early childhood health and development. Its primary aim is to provide evidence to support policy, planning and action for health and education across the country rather than to provide diagnostic data on individuals [11]. To this end, individual scores are aggregated to the school, neighbourhood, regional or country level. In 2009, Australia became the first country in the world to collect national data on the developmental health of all children at school entry. The first full national census conducted in 2009 has been followed with tri-annual data collection. Response rates for AEDC have been consistently high across each collection, ranging from 96.5-97.5% completion for the estimated number of eligible Australian students in each year [2].

Using data from the 2009 national collection of the AEDC, administrators of the AEDC have developed three categories of indicators to aid the interpretation of AEDC data; Domain Indicators, Vulnerability Summary Indicators and the Multiple Strengths Indicator [32]. The Domain Indicators use ranked scores from the 2009 AEDC collection to generate cut-offs for each domain. Students are classified as "developmentally vulnerable" (scores ranked below the 10th percentile), "developmentally at risk" (scores ranked between the 10th and 25th percentile), or "developmentally on track" (scores ranked above the 25th percentile) [32].

Based on the Domain Indicators, two Vulnerability Summary Indicators are generated. These are binary measures which refer to whether a participant is either developmentally vulnerable on one or more domain (DV1) or developmentally vulnerable on two or more domains (DV2) [32]. In this report, the DV1 variable is used as the key indicator of developmental vulnerability following the work of others [6].

Finally, the Multiple Strength Indicator (MSI) uses 39 items from the AEDC to measure developmental strengths. Scores for these items from the 2009 AEDC were ranked and used to generate cut-offs for three classifications; "highly developed strengths" (scores ranked above the 50th percentile), "well developed strengths" (scores ranked between the 25th and 50th percentile) and "emerging strengths" (scores below the 25th percentile) [32].

Links between the EDI and later outcomes

Most studies investigating the association of AEDC or Canadian EDI domains with later outcomes have focussed on academic achievement. All five EDI domains are generally found to be associated with later academic achievement, with lower ratings linked to poorer academic outcomes. For example, using the Canadian EDI, D'Angiulli et al., 2009 found that children with a vulnerability in any EDI domain in the first year of school were 2 to 3 times more likely to score 'below expectations' in numeracy, reading comprehension and writing skills at Grade 4 [34]. Two further studies of the Canadian EDI have demonstrated similar links between reading and numeracy in Grades 3 and 4 [35, 36]. In Australia, one study has examined associations between developmental vulnerability at school entry assessed using the AEDC and NAPLAN outcomes finding that they were equally strong in Years 3, 5 and 7 [37].

Few studies have investigated how AEDC measures relate to later wellbeing and behaviour outcomes. Early analyses suggest the AEDC has strong negative predictive validity for teacher-rated behaviour problems at 8 years of age, meaning that *not* being vulnerable in a domain at school entry is strongly predictive of *not* experiencing behavioural problems at age 8. However, experiencing vulnerability at school entry does not predict poor behavioural outcomes as strongly. In terms of social and emotional aspects of development, one Canadian study found the *Social Competence* domain in kindergarten to be the strongest predictor of self-reported connectedness to peers at Grade 4, and that *Emotional Maturity* at kindergarten most strongly predicted emotional wellbeing at Grade 4 [35].

Although there is some evidence of how early developmental vulnerability relates to outcomes in the middle years, few studies to date have been able to follow students longitudinally, and none with comprehensive data on non-academic outcomes. One likely reason is that the AEDC collects data only once every three years, so existing cohort studies are only able to link to AEDC data if their cohort was the correct age in an AEDC year. For example, the Longitudinal Study of Australian Children (LSAC) collects data across a two-year period in each wave, resulting in linkage of AEDC data for a proportion of the cohort. CATS is uniquely placed to fill this gap in the literature. As the study collects data annually, AEDC data is available for the entire cohort, allowing for direct data linkage with the AEDC dataset and providing an accurate picture of transitional outcomes through the middle years for students living in metropolitan Melbourne.

The Childhood to Adolescence Transition Study

This report presents findings from a linkage study involving the 2009 AEDC and CATS (Childhood to Adolescence Transition Study) datasets. CATS is an ongoing longitudinal study of Australian students which has followed over 1200 children in Melbourne since Year 3 (2012). The CATS study collects information on mental health and wellbeing, peer and family relationships, school engagement, and the primary to secondary school transition. Data is collected from students, their parents and teachers. CATS has also linked with the NAPLAN dataset to obtain robust data on student learning. Further information about CATS can be found in Appendix 1.

Aims of the report

This report follows an earlier report [5] from CATS which demonstrated the presence of strong inter-relationships between learning, wellbeing and school engagement in the middle years from Years 3 to 7. In particular, this report showed that student wellbeing and engagement in the mid-primary school years were strongly predictive of learning progress. For example, students experiencing persistent or even single episodes of poor wellbeing as indicated by emotional or behavioural problems and subjective self-report of wellbeing were more likely to disengage from school and on average fell up to a year behind their peers in their learning.

Whether these students are falling behind in primary school because of pre-existing vulnerabilities is an important question with significant implications. If students who begin their schooling with developmental vulnerabilities are at heightened risk of poor wellbeing and disengagement in the middle years there is a requirement to identify and support this group of students. Not only might developmentally vulnerable students be more prone to emerging problems in primary school; they may be more sensitive to the damaging effects of these problems. Of key interest is the developmental trajectories of students beginning school with a vulnerability or vulnerabilities. This report aims to investigate the proportion of these students who develop problems with school engagement, wellbeing and/or peer relationships, and subsequently fail to reach a minimum learning threshold. It also examines why some students begin with vulnerabilities and remain worse off in terms of education outcomes.

This report aims to identify all trajectories of learning and therefore also examines students who begin school with no apparent developmental vulnerabilities. It questions how many of these students remain at low risk and achieve key learning thresholds and how many increase in risk for poor outcomes. Students in this latter group, despite their 'problem-free' start, begin to decline in terms of social, emotional and behavioural functioning though mid- and late-primary school leading to problems with school engagement and learning. Should a considerable proportion of students be found to develop new problems in the middle years there will be a clear need to identify and support this group.

The current report utilises linkage of the 2009 AEDC dataset with longitudinal data on Victorian students from Year 3 to Year 7 from CATS. This dataset linkage provides a unique opportunity to examine the trajectories of wellbeing, engagement and learning from the point of entry into primary school through the first year of secondary school.

Based on the evidence presented above we expect that the linkage will identify:

- a group of students 'continuing at risk' i.e. a group with developmental vulnerability at school entry and who continue to perform poorly through the middle years in terms of mental, social, emotional and learning outcomes

- a group of students 'reducing in risk' i.e. a group with developmental vulnerability at school entry who improve in terms of social, emotional and behavioural functioning through mid- and late-primary school leading to improved learning outcomes by late primary and early secondary school
- a group of students 'continuing on track' who do not have early vulnerability and do not develop problems in the primary school years leading to good learning outcomes
- a group of students 'newly at risk' who do not have early vulnerability who start to decline in terms of social, emotional and behavioural functioning in mid- to late-primary school leading to problems with school engagement and learning by late primary and early secondary school.

The 2 key research questions examined in this report are:

1. *What is the relationship between early developmental vulnerability on the AEDC and later learning, school engagement and wellbeing?*
2. *How might any relationship between early developmental vulnerability and learning at Year 7 be affected by wellbeing and school engagement across Years 3, 4 and 5?*

The report is structured so that the first 4 chapters describe the relationship between developmental vulnerability and later outcomes, namely learning, school disengagement, wellbeing and peer relationships. Then in Chapter 5 we investigate the unique and combined effects of early developmental vulnerability and the middle years indicators of disengagement, wellbeing and peer relationships on student learning in Year 7.

Definition of Developmental Vulnerabilities

The AEDC assesses developmental vulnerabilities in five domains which are closely linked to child health, education and social outcomes. They include:

1. Physical health and wellbeing (children's physical readiness for the school day, physical independence and gross and fine motor skills).
2. Social competence (children's overall social competence, responsibility and respect, approach to learning and readiness to explore new things).
3. Emotional maturity (children's pro-social and helping behaviours and absence of anxious and fearful behaviour, aggressive behaviour and hyperactivity and inattention).
4. School-based language and cognitive skills (children's basic literacy, interest in literacy, numeracy and memory, advanced literacy and basic numeracy).
5. Communication skills and general knowledge (children's communication skills and general knowledge based on broad developmental competencies and skills).

In the first AEDC data collection cycle (2009) a series of cut-off scores was established for each of the five domains with children falling below the 10th percentile categorised as 'developmentally vulnerable' on that domain.

The AEDC produces a summary variable, DV1, which indicates if a student is developmentally vulnerable on one or more domains. This variable is used to define the developmentally vulnerable group for this report. A total of 184 CATS participants (17.7% of the AEDC-CATS linked dataset with data available on DV1 were classified as developmentally vulnerable.

Further information about the AEDC domains and developmentally vulnerable group in the CATS sample can be found in Appendix 3.

Results Chapter 1 – Learning

Key Analysis Questions

- Are students with early vulnerabilities destined to fail at school or are they able to overcome early difficulties to 'defy the odds' and succeed in their learning?
- Conversely, is there a group of students who, whilst presenting on entry to primary school with no sign of developmental vulnerabilities, fail to reach the Year 7 learning academic threshold?

Key Findings

- The gap between not-DV and DV students at Year 3 is equal to a one full year of learning.
- NAPLAN scores in Years 5 and 7 reveal a widening gap between the DV and not-DV groups which by Year 7 the not-DV group are over two years ahead of their DV peers in reading and numeracy outcomes.
- Only 63% of participants starting school DV attain the numeracy threshold.
- A higher proportion of not-DV students went on to attain the Year 7 reading threshold compared to DV students (84% not-DV, 55% DV).
- We found 66% and 64% of CATS participants who failed to meet the Year 7 reading and numeracy threshold respectively were not identified as DV at school entry.

In this section we examine the relationship between developmental vulnerability in the first year of primary school and later learning outcomes. Do students who start school with developmental vulnerabilities lag behind their peers academically? If so, does this learning gap shrink or widen as students progress through primary school? These questions are addressed by examining the average NAPLAN reading and numeracy achievement scores for the DV and non-DV groups at Years 3, 5 and 7 corresponding to the years for which NAPLAN assessments are available.

In the second part of this chapter we focus on learning success in Year 7. For our Victorian CATS cohort, Year 7 is the first year of secondary schooling and thus represents the culmination of primary school learning and a major transition point in their educational journey. The relationship between early developmental vulnerabilities and learning success at Year 7 is of key interest.

Learning success can be measured by a range of criteria, however, for the purposes of this report we use a measure of academic attainment as assessed by NAPLAN (refer to Appendix 2 for further details). In deciding how to set a minimum NAPLAN score indicative of learning success we have followed the approach taken by Lamb et al in their report on Educational Opportunity in Australia 2015 [6]. This report used an academic threshold (benchmark) for Year 7 learning success that is half a NAPLAN band higher than the national minimum standard (NMS). The NMS is set by ACARA as the second lowest band, Band 5 in Year 7 [7] and is reached by the vast majority of students; in 2016 95.5% of Australian Year 7 students achieved the NMS for numeracy and 94.6% achieved the NMS for reading. In setting the threshold higher than the NMS, Lamb suggested that this:

> *"… enables production of a more nuanced summary of learner progress at Year 7. While the NAPLAN NMS separates only those at the bottom end of the achievement spectrum from their peers, a higher benchmark identifies a larger*

proportion of learners whose learning is above the minimal level, but still cause for concern" [6]p.16.

Furthermore, this higher threshold was more comparable to the baseline levels of skills identified by international studies such as Progress in International Reading Literacy Study (PIRLS) and TIMSS.

Summary of learning outcomes at Years 3, 5 and 7

Mean numeracy and reading NSS were estimated in the DV and not-DV groups at each of Years 3, 5 and 7 (refer to Appendix 2: Regression analyses – part one, for further information how these estimates were calculated and Table 22 in Appendix 4: Supplementary results, for the associated β coefficient estimates). As expected, mean numeracy (Figure 1) and reading (Figure 2) NSS increased from Years 3 to 5 and from Years 5 to 7 for both groups. There was evidence to suggest that at each assessment point, the means for both numeracy and reading NSS are lower for the DV group compared to the not-DV group. For both numeracy and reading, the difference in estimated mean NSS between the groups appears to be greater at Year 3 than at Years 5 and 7.

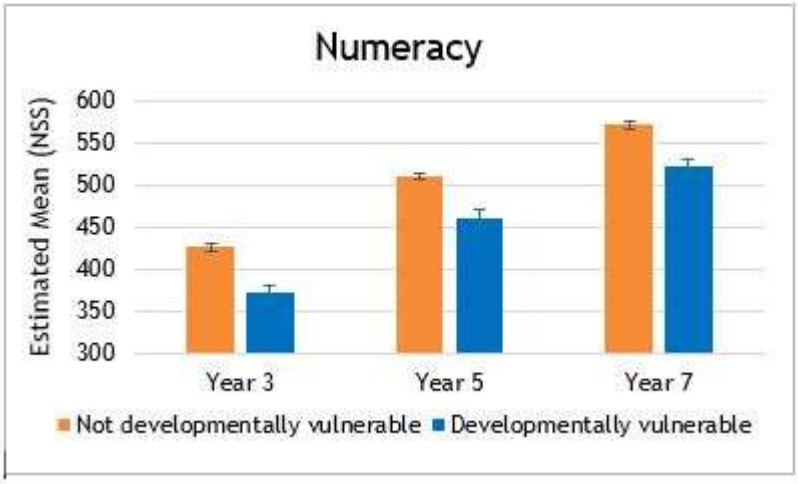


Figure 1. Mean numeracy NSS at Years 3, 5 and 7, by developmental vulnerability status.

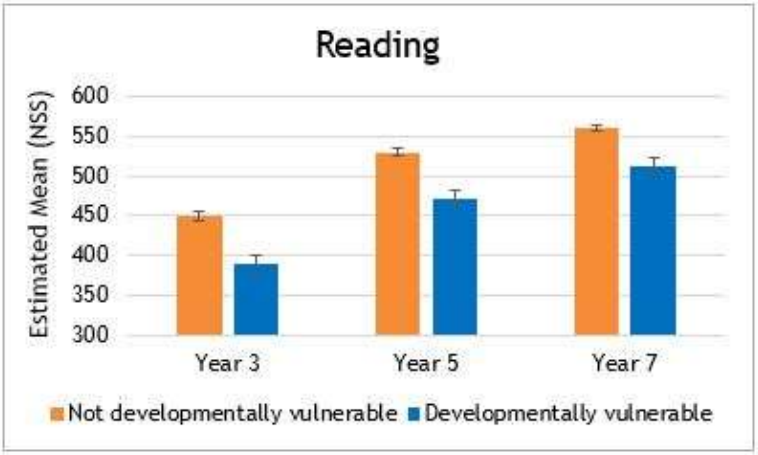


Figure 2. Mean reading NSS at Years 3, 5 and 7, by developmental vulnerability status.

The numeracy and reading NAPLAN band distributions by DV status are shown in Figure 3 and Figure 4 respectively. For both numeracy and reading at all 3 assessment points there is a greater proportion of DV participants in the bottom 2 bands and a lower proportion in the top 2 bands compared to not-DV participants.

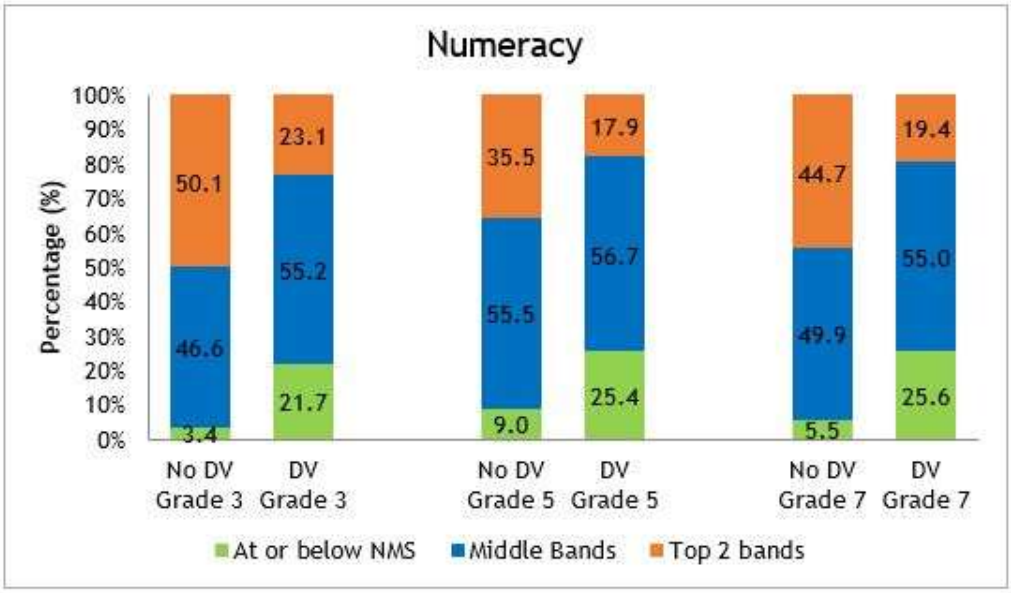


Figure 3. NAPLAN band distributions by DV status at Years 3, 5 and 7: numeracy.

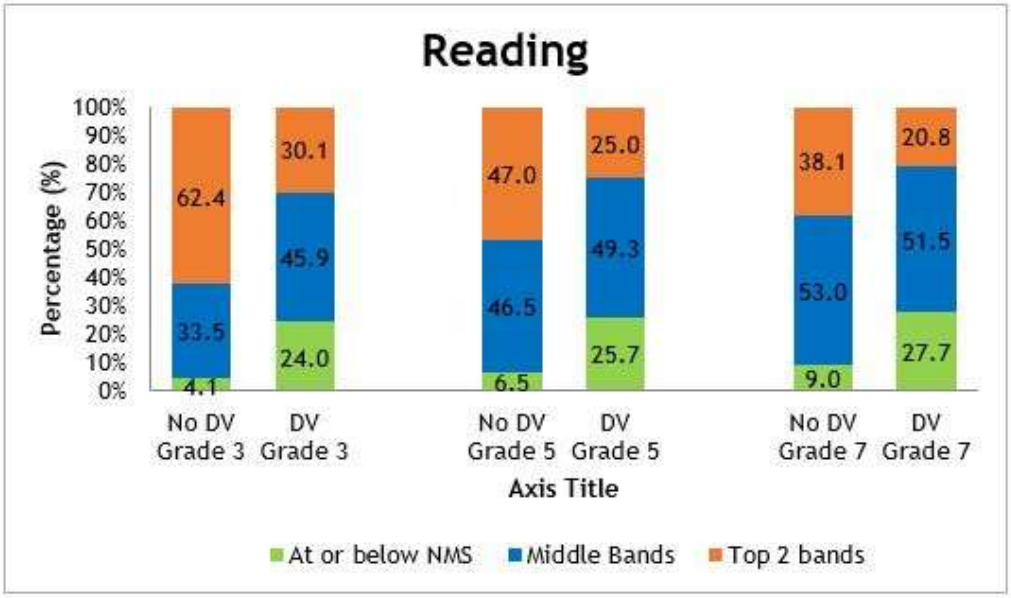


Figure 4. NAPLAN band distributions by DV status at Years 3, 5 and 7: reading.

The estimated mean numeracy and reading NSS can be expressed in terms of their Equivalent Years of Learning (EYL) (see Appendix 2 for further information). Table 1 presents the mean NSS from Figure 1 and Figure 2 and their EYL.

Table 1. Equivalent Years of Learning (EYL) for each estimated mean numeracy and reading NSS by developmental vulnerability status.

	Not developmentally vulnerable		Developmentally vulnerable		
	Estimated mean NSS	EYL	Estimated mean NSS	EYL	Learning Gap (years)
Numeracy					
Year 3	427.0	3.49	371.5	2.46	1.03
Year 5	510.4	5.72	461.7	4.25	1.47
Year 7	571.2	8.36	521.8	6.21	2.15
Reading					
Year 3	450.4	3.62	389.1	2.41	1.21
Year 5	529.3	6.16	471.3	4.14	2.02
Year 7	560.1	7.68	512.6	5.49	2.19

It can be seen in Table 1 that for numeracy, the not-DV group are tracking almost half a year ahead of the national average in Year 3 (which by definition is set at 3 years) whereas the DV group are around half a year behind the national average. The gap between not-DV and DV groups at Year 3 is equal to a full year of learning. The scores in Years 5 and 7 reveal a widening gap between the DV and not-DV groups such that by Year 7 the not-DV group are over two years ahead of their DV peers. The results for reading are very similar to those for numeracy with a greater than 2 year gap in learning between DV and not DV groups apparent at Year 7.

Relationship between developmental vulnerability and Year 7 learning success

A total of 83.8% of participants in the CATS sample attained the Year 7 numeracy learning threshold and 79.1% attained the Year 7 reading threshold. We then examined the number of students in each of 4 possible pathways between DV status in the first year of primary school and Year 7 learning success: (1) starting school with DV and failing to attain the Year 7 threshold [continuing at risk]; (2) starting DV and attaining the Year 7 threshold [reducing in risk]; (3) starting school not-DV and attaining the Year 7 threshold [continuing on track] and (4) starting school not-DV and failing to reach the Year 7 threshold [newly at risk]. The numbers in these groups are illustrated in Figure 5 and Figure 6 on the following page.

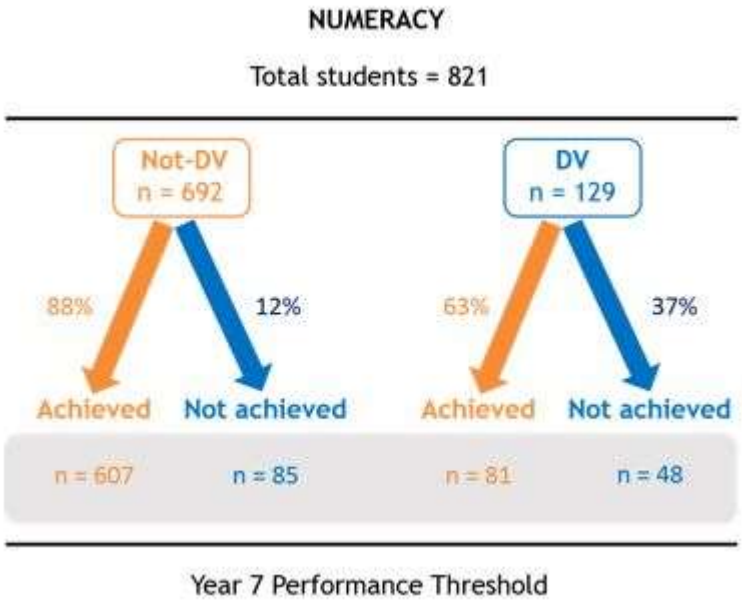


Figure 5. Pathways of development and learning between the first year of primary school and Year 7: numeracy.

It can be seen in Figure 5 that the vast majority of students starting school not-DV go on to attain the Year 7 numeracy threshold (87.7%). In contrast, only 62.8% of participants starting school DV attain the numeracy threshold. From this analysis we can see that DV status is not a precise indicator of future learning success given that of the 133 CATS participants failing to reach the Year 7 numeracy threshold, 85 (63.9%) did not present with any DV indicators at school entry.

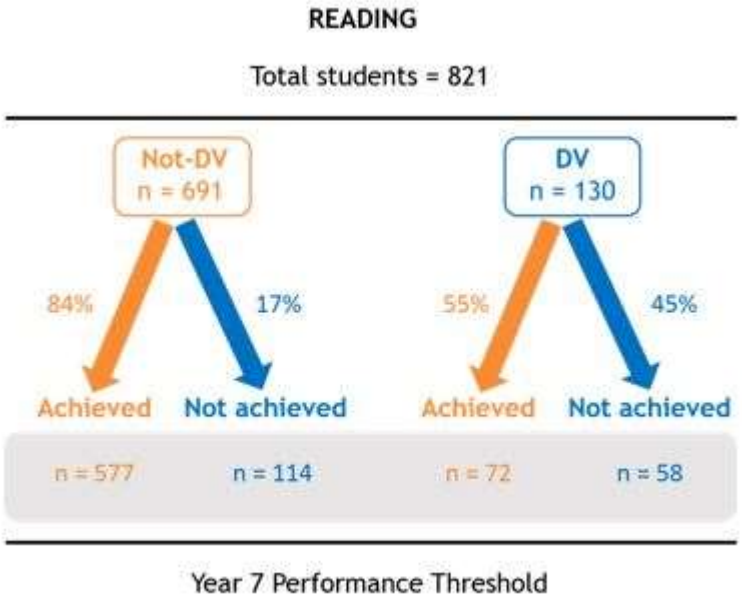


Figure 6. Pathways of development and learning between the first year of primary school and Year 7: reading.

Figure 6 shows similar trends to those seen for the Year 7 numeracy learning outcome. A higher proportion of not-DV students went on to attain the Year 7 reading threshold compared to DV students (83.5% not-DV, 55.4% DV). Reaffirming our previous observation, we found 114 (66.3%) of the 172 CATS participants who failed to meet the Year 7 reading threshold were not identified as DV at school entry.

The demographic characteristics of the 4 developmental groups are shown in Table 2 (numeracy) and Table 3 (reading). Some gender differences are observed: for numeracy, although similar proportions of boys and girls remain on track (90.5% boys, 85.6% girls) a higher proportion of boys who started school with DV went on to attain the Year 7 learning threshold compared to girls (66.7% boys, 56.9% girls). These differences were less apparent for the reading outcome (56.4% boys, 53.9% girls).

The majority of ATSI learners starting school with DV attained the Year 7 learning thresholds (80.0% numeracy and reading). Although caution needs to be used when interpreting these values given the relatively low numbers of ATSI students in the CATS sample, there appears to be higher proportions of ATSI students catching up compared to non-ATSI students (numeracy: 80.0% ATSI, 62.5% non-ATSI; reading 80.0% ATSI, 54.9% non-ATSI).

The proportion of students in Catholic schools who started school with DV and attained the Year 7 learning thresholds was higher than for students attending government schools (numeracy: 78.6% Catholic, 57.6% government; reading 67.9% Catholic, 51.0% government).

There were no clear trends according to country of birth, language spoken or SES.

Table 2. Demographic characteristics of the four developmental groups: numeracy.

	Not developmentally vulnerable (n = 692)		Developmentally vulnerable (n = 129)	
	Attained Year 7 threshold	Below threshold at Year 7	Attained Year 7 threshold	Below threshold at Year 7
Overall	87.7	12.3	62.8	37.2
Gender				
Boys	90.5	9.5	66.7	33.3
Girls	85.6	14.4	56.9	43.1
Country of birth^				
Australia	87.2	12.8	63.4	36.6
Other	93.6	6.4*	61.5	38.5*
Indigenous status^				
Non-ATSI	87.6	12.4	62.5	37.5
ATSI	88.2	11.8*	80.0*	20.0*
SEIFA quintile (at Year 3)				
Lowest	85.5	14.5	60.0	40.0
Lower middle	76.6	23.4	55.6	44.4
Middle	86.3	13.7	66.7	33.3*
Upper middle	89.0	11.0	53.3	46.7
Highest	89.8	10.2	73.2	26.8
Language background^				
English	87.4	12.6	65.4	34.6
English and another language	96.7	3.3*	55.6*	44.4*
Another language, no English	97.2	2.8*	70.0	30.0
ESL^				
No	87.1	12.9	61.1	38.9
Yes	92.3	7.7	66.7	33.3
School sector (at Year 3)				
Government	87.1	12.9	57.6	42.4
Catholic	89.3	10.7	78.6	21.4
Independent	87.5	12.5*	100.0*	0.0*

* interpret with caution since cell number is n = 5 or less
^ percentages are based on valid data i.e. there are missing data on the demographic variable

Table 3. Demographic characteristics of the four developmental groups: reading.

	Not developmentally vulnerable (n = 682)		Developmentally vulnerable (n = 129)	
	Attained Year 7 threshold	Below threshold at Year 7	Attained Year 7 threshold	Below threshold at Year 7
Overall	83.5	16.5	55.4	44.6
Gender				
Boys	80.9	19.1	56.4	43.6
Girls	85.5	14.5	53.9	46.2
Country of birth^				
Australia	84.6	15.4	56.1	43.9
Other	77.6	22.5	53.9	46.2
Indigenous status^				
Non-ATSI	84.5	15.5	54.9	45.1
ATSI	78.1	21.9	80.0*	20.0*
SEIFA quintile (at Year 3)				
Lowest	72.4	27.6	53.9	46.2
Lower middle	75.6	24.4	38.9	61.1
Middle	79.6	20.4	53.3	46.7
Upper middle	83.5	16.5	62.1	37.9
Highest	89.1	10.9	59.5	40.5
Language background^				
English	85.9	14.1	55.6	44.4
English and another language	71.0	29.0	77.8	22.2*
Another language, no English	81.1	18.9	70.0	30.0
ESL^				
No	84.5	15.5	53.9	46.2
Yes	76.0	24.1	59.0	41.0
School sector (at Year 3)				
Government	82.4	17.6	51.0	49.0
Catholic	85.6	14.4	67.9	32.1
Independent	87.5	12.5*	100.0*	0.0*

* interpret with caution since cell number is n = 5 or less
^ percentages are based on valid data i.e. there are missing data on the demographic variable

Results Chapter 2 – School Disengagement

Key Analysis Questions

- Is developmental vulnerability status at school entry predictive school disengagement in later years, specifically Years 3 to Years 7?

Key Findings

- A much larger proportion of DV students compared to not-DV students were observed to be disengaged in their schooling at Year 4 (17.2% versus 8.2%).
- The high level of disengagement in DV students persisted across primary school years and into Year 7.
- The not-DV group demonstrated increasing levels of school disengagement across primary school years and into Year 7.
- Early disengagement is problematic since it has been linked to poorer learning outcomes but is of particular concern because of the known reciprocal relationship between engagement and learning.

In this section we examine the relationship between developmental vulnerability in the first year of primary school and later school disengagement. School disengagement is characterised by low attendance and participation, a lack of motivation for learning and low connection with teachers and school. Disengaged students are at risk of a range of adverse academic and social outcomes including lower academic achievement and school dropout [38]. It has been suggested that students starting school with low school readiness are more likely to be disengaged [39] although few research studies have examined this directly.

Summary of school disengagement at Years 4 to 7

The proportions of disengaged students were estimated in the DV and not-DV groups at each year level. See Appendix 2: Regression analyses - part one, for further information on how these estimates were calculated and Table 23 in Appendix 4: Supplementary results, for the associated odds ratio estimates.

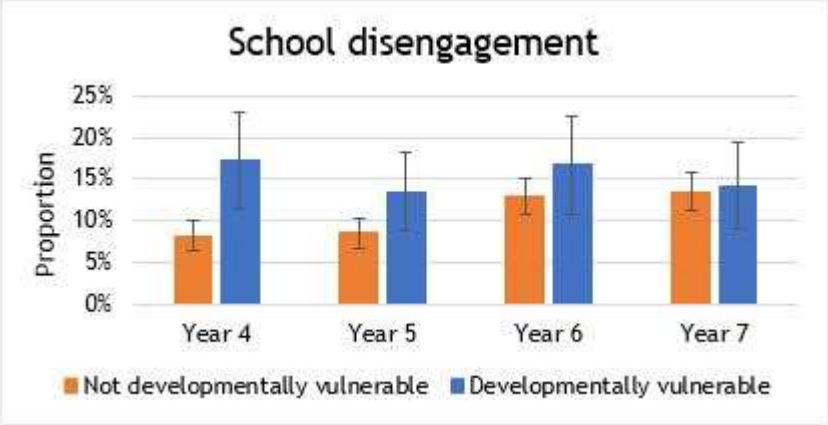


Figure 7. Proportion of disengaged students by developmental vulnerability status in Years 4, 5, 6 and 7.

Overall, levels of disengagement ranged from 8.2% to 17.2%. There was a marked difference in the proportion of disengaged students in Year 4 by DV status with more DV than not-DV students being disengaged (17.2% DV, 8.2% not-DV). The relatively high level of disengagement amongst the DV group was maintained across the primary school years and into Year 7. In contrast, the not-DV group displayed increasing levels of disengagement in Years 5 and 6.

The finding that around 1 in 6 students with DV are disengaged from school in Year 4 is concerning. Our measure of disengagement in Year 4 is quite stringent with only students reporting they do not like their school or their teacher 'at all' and/or they 'never' or 'only a little' try their best at school being classified as disengaged. Only 1 in 14 not-DV students met this criteria in Year 4. Early disengagement (disengagement suggests a removal or loss of engagement although it is possible that this group of students never engage with school from the outset) is problematic since it has been linked to poorer learning outcomes but is of particular concern because of the reciprocal relationship observed between engagement and learning. Whilst disengagement is linked to poorer learning outcomes, poor academic progress can increase risk of disengagement [5, 39].

Risk of disengagement by developmental vulnerability status

Logistic regression models were used to estimate associations between DV status and school disengagement. All models were adjusted for child age (at time of AEDC), child sex, and SES (see Appendix 2: Regression analyses - part one, for further details). Table 4 shows the odds ratios for disengagement in the DV versus the not-DV group at each year level. The likelihood of disengagement was almost two times higher for the DV group in Year 4. In Year 5 the DV group were 1.64 times as likely to be disengaged. No differences were observed by Year 6 and 7 which is likely to be due to increased levels of disengagement amongst the not-DV group in Years 6 and 7, rather than a decrease in the DV group as shown in the prevalence data presented in Figure 7.

Table 4. Likelihood of student disengagement in Year 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Year 4		
Not-DV	Ref	
DV	1.96	1.17 to 3.29
Year 5		
Not-DV	Ref	
DV	1.64	0.99 to 2.70
Year 6		
Not-DV	Ref	
DV	1.23	0.74 to 2.03
Year 7		
Not-DV	Ref	
DV	0.97	0.59 to 1.59

Analyses controlled for gender, SEIFA advantage/disadvantage quintile and age.
Ref – the reference group with an odds ratio of 1

Results Chapter 3 – Wellbeing

Key Analysis Question

- Is there a relationship between early developmental vulnerability at school entry and future wellbeing of students in Year 3 to Year 7?

Key Findings

- In Year 3 twice as many students in the DV group were identified as having behaviour problems (42.2% compared to 19.0% for not-DV group).
- There was evidence of a trend for the proportion of DV students with behaviour problems to decline over time from 42.2% in Year 3 to 33.0% in Year 6.
- Both DV and not-DV groups of students were found to have the greatest proportion of emotional problems in Year 3.
- In later years, Years 4 and 5 emotional problems were vastly higher in the DV compared to the not-DV group (47.4% versus 33.5%).
- By Years 6 and 7 the difference between the DV and not-DV groups regarding emotional problems was no longer present.
- At all year levels greater proportions of the DV group reported low subjective wellbeing in comparison to the not-DV group.

Wellbeing is defined here as the psychological, cognitive, social and physical functioning and capabilities that students need to live a happy and fulfilling life. Student wellbeing is an important outcome of education and it is now well recognised that schools play an important role. As the 2015 PISA report on students' wellbeing states:

"Schools are not just places where students acquire academic skills; they also help students become more resilient in the face of adversity, feel more connected with the people around them, and aim higher in their aspirations for their future. Not least, schools are the first place where children experience society in all its facets, and those experiences can have a profound influence on students' attitudes and behaviour in life." [45] p.5

Schools and education systems are no longer a place simply for 'traditional' academic learning, they must also provide an environment to nurture and enhance student's psychological, cognitive, physical and social skills to optimise student wellbeing and future life capacity. In light of this knowledge, over recent years a review of policy focus has seen the introduction of additional curricula programmes. These programmes focus on the acquisition and advancement of social and emotional skills with the purpose of driving students to achieve positive life outcomes (for example, see [27]).

Furthermore, student wellbeing has profound implications for student learning and school engagement as was seen in a previous report from the CATS study. This previous work demonstrated a positive relationship between student wellbeing in the middle years and later learning and school engagement [8]. The relationships between wellbeing and engagement and learning are reciprocal and likely to be reinforced over time.

Wellbeing is a multi-faceted concept incorporating both subjective experience and objective circumstances. Wellbeing is therefore rated using 3 indicators: (1) student self-report of their

emotional problems (depression and anxiety); (2) teacher-report of behaviour problems; and (3) students' own rating of their happiness and quality of life (subjective wellbeing).

To date, there has been just a single Canadian report in the research literature demonstrating a relationship between DV at school entry and lower levels of emotional wellbeing at age 10 (Year 4) [39]. However, the relationship between early DV and future wellbeing of Australian students has not been examined to date and is the focus of this chapter.

Summary of Student Wellbeing at Years 3 to 7

The proportions of the sample positive for each indicator of poor wellbeing at each year level were estimated for the DV and not-DV groups (see Appendix 2: Regression analyses – part one, for further details and Table 24 in Appendix 4: Supplementary results, for the associated odds ratio estimates).

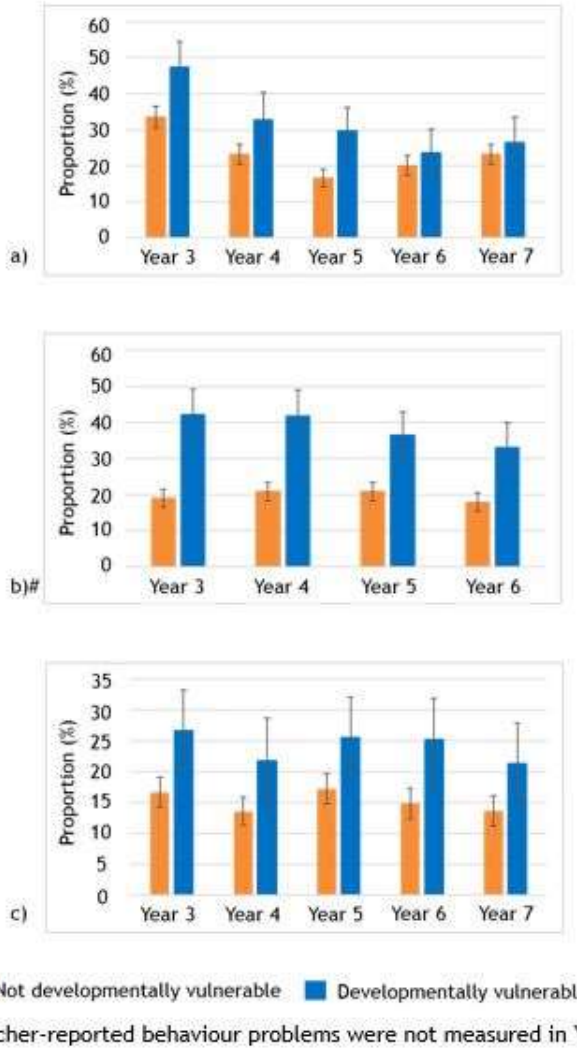


Figure 8. Proportion of students with a) emotional problems b) behaviour problems and c) low subjective wellbeing by developmental vulnerability status in Years 3, 4, 5, 6 and 7.

The proportion of students with emotional problems was highest for both groups in Year 3 (Figure 8a). In Years 3, 4 and 5 rates of emotional problems were markedly higher in the DV group

compared to the not-DV group. For example, in Year 3, 47.4% students with DV reported emotional problems compared to 33.5% not-DV students. There was no evidence of a difference between groups in Years 6 and 7.

It can be seen from Figure 8b that the proportions of students with behaviour problems were higher for the DV group compared to the not-DV group at all year levels. In Year 3 twice as many students in the DV group had behaviour problems (42.2% compared to 19.0% for not-DV group). Unlike the not-DV group which had stable rates of behaviour problems at all year levels, there is a trend for the proportion of DV students with behaviour problems to decline over time from 42.2% in Year 3 to 33.0% in Year 6.

Figure 8c shows that at all year levels greater proportions of the DV group reported low subjective wellbeing compared to the not-DV group. The proportions didn't vary much across year levels with around 1 in 4 DV students and around 1 in 7 not-DV students reporting low wellbeing in Years 3 to 7.

Likelihood of poor wellbeing by developmental vulnerability status

The association between DV status and student wellbeing was investigated in logistic regression analyses. These analyses also took the gender, age, and SES of each participant into account (see Appendix 2: Regression analyses – part one, for further details). Table 5, Table 6 and Table 7 show the odds ratios (ORs) for emotional problems, behaviour problems and low subjective wellbeing in the DV group versus the not-DV group at each year level. The likelihood of emotional problems was 1.56 to 2.22 times higher for the DV group in Years 3, 4 and 5. There was no difference between the groups in Years 6 and 7 suggesting that the association between DV and later emotional problems becomes less apparent over time.

Developmental vulnerability was associated with behaviour problems at all year levels assessed (Years 3 to 6). The strongest association was observed in Year 3 where students with DV were 3 times as likely as not-DV students to experience behaviour problems.

Low subjective wellbeing was also more likely in the DV group than the not-DV group in Years 3 to 7. Interestingly, the odds of low wellbeing in the DV group appear to increase in later years with DV students 57% more likely to report low wellbeing in Year 3 and 90% more likely in Year 7.

Table 5. Likelihood of emotional problems in Year 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Year 3		
Not-DV	Ref	
DV	1.78	1.27 to 2.49
Year 4		
Not-DV	Ref	
DV	1.56	1.02 to 2.36
Year 5		
Not-DV	Ref	
DV	2.22	1.51 to 3.25
Year 6		
Not-DV	Ref	
DV	1.33	0.84 to 2.10
Year 7		
Not-DV	Ref	
DV	1.28	0.82 to 1.98

Analysis controlled for gender, SES and age

Table 6. Likelihood of behaviour problems in Year 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Year 3		
Not-DV	Ref	
DV	3.00	2.05 to 4.38
Year 4		
Not-DV	Ref	
DV	2.42	1.63 to 3.59
Year 5		
Not-DV	Ref	
DV	1.92	1.34 to 2.76
Year 6		
Not-DV	Ref	
DV	2.15	1.42 to 3.24

Analysis controlled for gender, SES and age

Table 7. Likelihood of low subjective wellbeing in Year 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Year 3		
Not-DV	Ref	
DV	1.57	1.04 to 2.37
Year 4		
Not-DV	Ref	
DV	1.74	1.05 to 2.90
Year 5		
Not-DV	Ref	
DV	1.66	1.12 to 2.48
Year 6		
Not-DV	Ref	
DV	1.77	1.14 to 2.75
Year 7		
Not-DV	Ref	
DV	1.90	1.15 to 3.14

Analysis controlled for gender, SES and age

Results Chapter 4 – Peer relationships

Key Analysis Questions

- Are students with early vulnerabilities more likely to be bullied in the middle years?
- Are these same students less likely to form friendship groups and receive peer support?

Key Findings

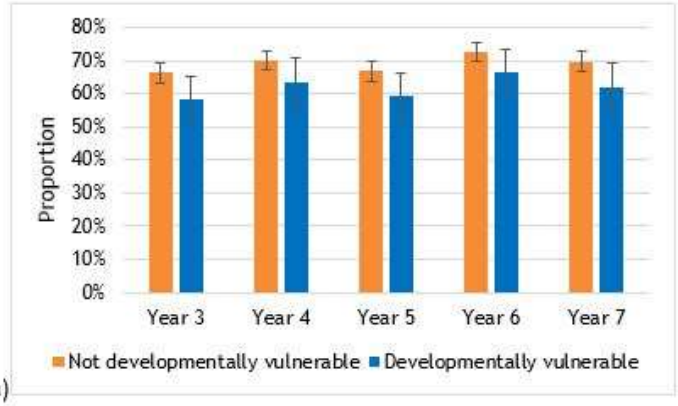
- At Year 3 a lower proportion of DV students had support from peers when compared to not-DV (58.3% compared to 66.5%).
- Rates of bullying in both groups declined between Years 3 and 6 yet a greater proportion of DV students consistently reported recent bullying.
- DV students at Year 5 were 52% more likely to report experiencing recent bullying compared to their not-DV peers.

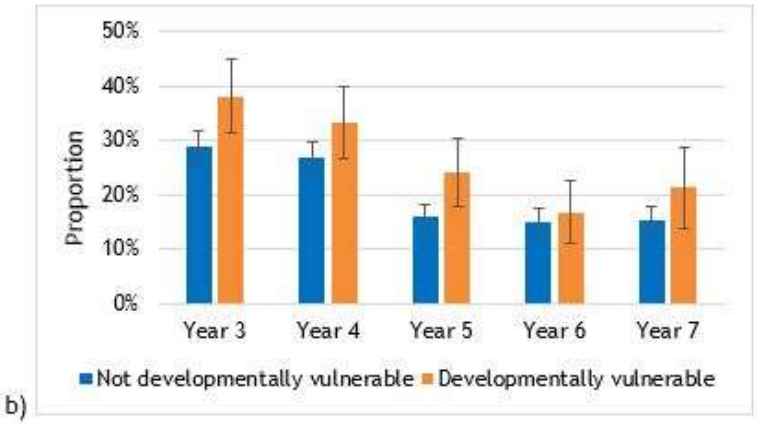
In this chapter we investigate the relationship between early DV and positive and negative aspects of peer relationships. Schools are places of academic learning and are also fundamentally important settings for the formation and development of peer relationships. Lack of peer support is a risk factor for school disengagement [39] and bullying has known negative effects on student wellbeing and learning [40-42]. Students with poorer quality peer relationships are also more likely to experience bullying [43], while having more supportive friendships may reduce the negative impact of bullying on learning [42]. The effects of bullying and peer support on learning were observed in a recent report from the CATS study on Australian middle school students which showed that students without peer support were twice as likely to be disengaged in Year 7 and students who were persistently bullied in Years 3 to 5 were almost a year behind in numeracy by Year 7 [5].

Summary of Peer relationships at Years 3 to 7

The proportions of students with good peer support and experiencing bullying (peer victimization) were estimated in the DV and not-DV groups at each year level. See Appendix 2: Regression analyses - part one, for further information on how these estimates were calculated and Table 25 in Appendix 4: Supplementary results, for the associated odds ratio estimates.

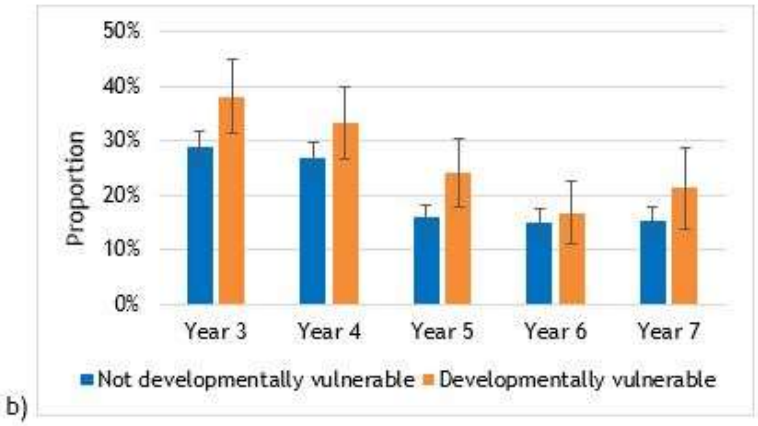
a)





b)

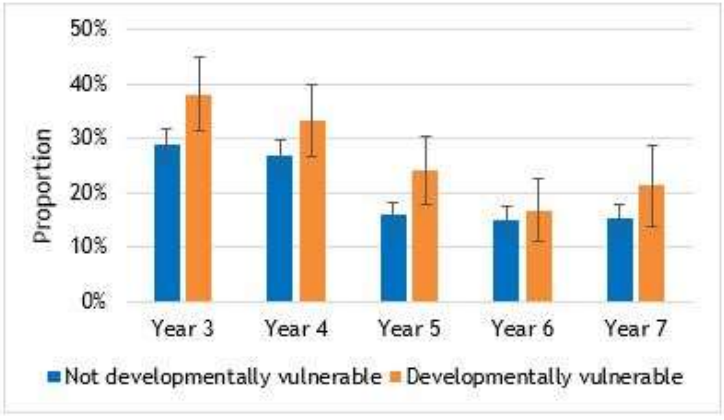
Figure 9. Proportion of students reporting a) peer support and b) bullying by developmental vulnerability status in Years 3, 4, 5, 6 and 7.



b)

In Figure 9 it can be seen that at Year 3 a higher proportion of DV students experienced bullying (DV 38.1%, not-DV 29.0%), whereas a lower proportion had support from peers (DV 58.3%, not-DV 66.5%), although the 95% confidence intervals for these estimates overlap slightly.

After Year 3 the proportion of students reporting peer support was relatively stable and did not appear to differ between the DV and not-DV groups (



b)

Figure 9a).

As can be seen in b)

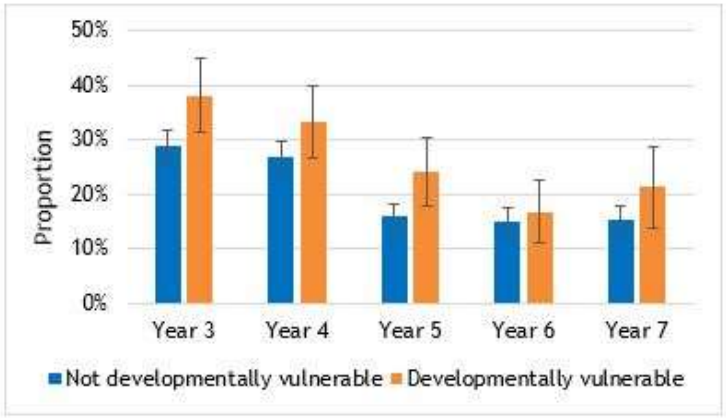


Figure 9b, there was a trend for higher proportions of DV students reporting a recent experience of being bullied compared to not-DV students. The proportion of students bullied reduced each year between Years 3 and 6 for both the DV and not-DV groups (DV from 38.1% to 16.7%, not-DV from 29.0% to 14.9%).

Likelihood of peer relationship outcomes by developmental vulnerability status

The association between DV status and student reports of peer support and bullying was investigated in logistic regression analyses. These analyses also took the gender, age, and SES of each participant into account (see Appendix 2: Regression analyses - part one). Table 8 and Table 9 show the odds ratios (ORs) for peer support and bullying in the DV group versus the not-DV group at each year level. There was no evidence for an association between DV status and peer support, at any of the five year levels. For bullying, DV students were 1.52 times as likely (52% more likely) to experience bullying in Year 5 compared to the not-DV group. Results for other year levels were not statistically significant.

Table 8. Estimated likelihood of peer support in Year 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Year 3		
Not-DV	Ref	
DV	0.73	0.52 to 1.04
Year 4		
Not-DV	Ref	
DV	0.74	0.50 to 1.09
Year 5		
Not-DV	Ref	
DV	0.79	0.56 to 1.11
Year 6		
Not-DV	Ref	
DV	0.80	0.56 to 1.14
Year 7		
Not-DV	Ref	
DV	0.75	0.52 to 1.09

Analysis controlled for gender, SES and age.

Table 9. Estimated likelihood of bullying in Year 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Year 3		
Not-DV	Ref	
DV	1.39	0.99 to 1.96
Year 4		
Not-DV	Ref	
DV	1.23	0.86 to 1.75
Year 5		
Not-DV	Ref	
DV	1.52	1.01 to 2.29
Year 6		
Not-DV	Ref	
DV	1.16	0.68 to 1.98
Year 7		
Not-DV	Ref	
DV	1.44	0.86 to 2.39

Analysis controlled for gender, SES and age

Chapter 5 – Relationships between DV, middle years indicators and Year 7 learning

Key Analysis Questions

- Given early DV and the middle years indicators are each predictive of learning outcomes the question then arises as to how they are mechanistically related.
- Are education outcomes mostly determined early (by the time a student starts primary school) with their negative effects accounted for by an increased risk of problems in the middle years?
- Or do problems emerge in the middle years regardless of early DV, which independently lead to poorer learning outcomes?

Key Findings

- Students with DV were 1.73 times as likely as not-DV students to have had a single episode and 2.42 times as likely to have experienced persistent emotional problems.
- For numeracy, the DV group were 4.53 times as likely to not attain the Year 7 academic threshold, after controlling for gender, age and SES.
- Suggesting DV status at school entry is strongly associated with later academic performance.
- Students with persistent emotional problems were almost 3 times as likely to not attain the Year 7 academic threshold compared to their peers without emotional problems (odds ratio = 2.67).
- The results for non-attainment of the reading Year 7 learning threshold followed the same pattern as for the numeracy.
- DV students were 3.45 times as likely to not reach the reading threshold.
- Disengagement, emotional problems, persistent behaviour problems, poor subjective wellbeing and persistent bullying were each associated with higher likelihood of not attaining the reading threshold.
- Our findings suggest that the strong relationship between middle years indicators and learning outcomes is largely independent of DV status at school entry suggesting that problems in the middle years, whether emergent or not, are important risk factors for poor learning outcomes.

In this chapter we consider the important preceding influences on learning success as a student moves into secondary education. We investigate the combined influence of early developmental vulnerabilities and middle years indicators of wellbeing, peer relationships and engagement on Year 7 learning (non-attainment of the Year 7 learning threshold described in Chapter 1). In an earlier report from CATS, we demonstrated a strong relationship between the middle years indicators and learning outcomes highlighting the importance of social and emotional factors for optimal learning [5]. Chapter 1 of the current report highlighted the relationship between DV and learning outcomes demonstrating the predictive validity of the AEDC for learning success.

Chapters 2, 3 and 4 of this report show that indicators of DV apparent in the first year of school are highly predictive of school disengagement (Chapter 2), poor wellbeing (Chapter 3), and, to a lesser extent, poorer peer relationships (Chapter 4). In these chapters the relationship was examined at each year level separately enabling us to determine the changing strength of the relationship across

time. In the current chapter, we draw on the indicators used in a previous CATS report [5] which distinguish between single episodes and persistent problems (the problem is present on two or three years at Year 3, 4 or 5). To summarise the relationship between DV and these indicators, multinomial regressions were used to produce the risk ratios shown in Table 10 (further details are provided in Appendix 2: Regression analyses – part two). These show the increase in risk of persistent or single episodes of problems relative to no problems for the DV group compared to the not-DV group.

Table 10. Effect of developmental vulnerabilities at school entry on middle years indicators of wellbeing, engagement and peer relationships.

	Estimated proportion (%)	Risk Ratios[a]	95% Confidence Interval
Emotional problems			
None	47.8	Ref	
Single episode	31.0	1.73	1.17 to 2.57
Persistent	21.2	2.42	1.59 to 3.68
Behaviour problems			
None	59.7	Ref	
Single episode	19.7	1.38	0.87 to 2.19
Persistent	20.5	3.18	2.10 to 4.81
Poor subjective wellbeing			
None	62.9	Ref	
Single episode	25.0	1.76	1.12 to 2.77
Persistent	12.0	2.06	1.22 to 3.48
Disengagement [a]			
None	83.1	Ref	
1 or 2 years	16.9	1.85	1.19 to 2.87
Peer support			
None	14.9	Ref	
Single episode	15.8	1.50	0.97 to 2.31
Persistent	69.3	1.28	0.80 to 2.06
Peer bullying			
None	50.0	Ref	
Single episode	29.5	1.15	0.76 to 1.74
Persistent	20.5	1.60	1.07 to 2.39

*Adjusted for child gender, child age (at school entry), and child SEIFA advantage/disadvantage quintile (at Year 3).
[a] This estimate is an odds ratio not a risk ratio since it was calculated from a logistic regression model, rather than a multinomial logistic regression model.

Table 10 confirms that DV students are at increased risk of experiencing emotional problems in the middle years compared to not-DV students. Students with DV were 1.73 times as likely as not-DV students to have had a single episode and 2.42 times as likely to have experienced persistent emotional problems. Similar effects were noted for behaviour problems and poor subjective wellbeing. The odds of disengagement for students with DV were 1.85 times higher than for not-DV students. Examination of the peer relationship indicators shows that DV status was not associated

with peer support and single episodes of bullying but the risk for persistent bullying was 1.60 times higher for the DV group.

Next, we ran a series of logistic regression models predicting non-attainment of the Year 7 learning threshold (described in Chapter 1). In the first step, DV1 was regressed on the learning outcome along with the covariates age, gender and SES to determine the relative likelihood of failing to attain the threshold for the DV versus the not-DV groups. In Step 2 the middle years indicators (separately) were regressed on the learning outcome along with the same covariates in order to show the change in likelihood associated with single episode and persistent problems. Finally, in Step 3, both DV and the middle years indicators were included in the regression model, along with the covariates to show the associations between DV1 and learning outcomes and middle years indicators and learning outcome in the presence of each other. The series of models were run for numeracy and reading learning outcomes separately. Missing data were handled using multiple imputation; a total of 20 complete data sets were imputed (refer to Appendix 2 for a summary of missing data and details of the multiple imputation procedure).

Table 11. Results of separate logistic regression models predicting non-attainment of the Year 7 numeracy threshold with predictors: DV (Step 1), middle years indicator (Step 2), and DV and middle years indicator together (Step 3).

a) Middle years indicator - school disengagement

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	4.53 (2.98-6.89)		4.32 (2.80-6.66)
School disengagement			
None		1	1
1 or 2 years		2.60 (1.71-3.94)	2.38 (1.52-3.71)

b) Middle years indicator - emotional problems

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	4.53 (2.98-6.89)		4.16 (2.71-6.37)
Emotional problems			
None		1	1
Single episode		1.77 (1.18- 2.66)	1.61 (1.05- 2.47)
Persistent		2.67 (1.76- 4.05)	2.29 (1.46- 3.57)

c) Middle years indicator - behaviour problems

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	4.53 (2.98-6.89)		4.03 (2.63-6.17)
Behaviour problems			
None		1	1
Single episode		1.53 (0.99-2.37)	1.46 (0.92-2.33)
Persistent		2.99 (1.98- 4.52)	2.38 (1.55-3.66)

d) Middle years indicator - poor subjective wellbeing

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	4.53 (2.98-6.89)		4.23 (2.78-6.46)
Poor subjective wellbeing			
None		1	1
Single episode		2.05 (1.38-3.04)	1.87 (1.24-2.80)
Persistent		2.18 (1.36-3.50)	1.91 (1.17-3.12)

e) Middle years indicator - peer support

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	4.53 (2.98-6.89)		4.54 (3.00-6.89)
Peer support			
None		1	1
Single episode		1.02 (0.58-1.80)	1.07 (0.58-1.96)
Persistent		0.92 (0.57-1.49)	1.03 (0.62-1.69)

f) Middle years indicator - bullying

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	4.53 (2.98-6.89)		4.43 (2.90-6.76)
Bullying			
None		1	1
Single episode		1.29 (0.88-1.88)	1.27 (0.86-1.89)
Persistent		1.74 (1.14-2.65)	1.59 (1.02-2.48)

* adjusted for child gender, child age (at school entry), and child SEIFA advantage/disadvantage quintile (at Year 3).

For numeracy, the DV group were 4.53 times as likely to not attain the Year 7 threshold, after controlling for gender, age and SES (Step 1, which is provided in each table to aid comparisons),

indicating that DV is strongly associated with later academic performance. Emotional problems in Years 3-5, especially persistent ones throughout this period, are also highly associated with later academic performance. Students with persistent emotional problems were almost 3 times as likely to not attain the Year 7 threshold compared to their peers without emotional problems (OR=2.67, Table 11b, Step 2). Similar associations were observed for behaviour problems (OR for persistent problems =2.99, Table 11c, Step 2) and subjective wellbeing (OR for persistent poor wellbeing=2.18, Table 11d, Step 2) and disengagement (OR=2.60, Table 11a, Step 2). The strength of the association with the bullying indicator was slightly lower (OR for persistent bullying =1.74, Table 11f, Step 2) and the peer support indicator showed no evidence for an association (Table 11e, Step 2). These associations appear to be relatively independent of whether the student was vulnerable to begin with since there is little change in the odds ratios when DV1 was added to the models (e.g. for emotional problems in Table 11b, Step 3). This suggests that emotional problems in the middle years, whether emergent or not, represent an important risk factor for academic failure. In addition, the association between DV and academic failure appears to be independent of later emotional problems. This suggests that there could be important pathways, other than emotional problems, by which DV students result in academic failure. The pattern of findings for disengagement, behaviour problems, subjective wellbeing, and bullying were similar with little change in the ORs when DV1 and the middle years indicator were included in the models together (Step 3 in Table 11a, Table 11c, Table 11d and Table 11f respectively).

The results for non-attainment of the reading Year 7 learning threshold followed the same pattern as for the numeracy outcome and are presented in Appendix 4.

In summary, the results presented in this chapter suggest that a small part of the effects of DV on later learning outcomes are likely to be due to the increased risk of wellbeing, engagement and peer relationship problems in the middle years. However, much of the effect of DV on learning operates through other pathways yet to be identified. Importantly, the results show that the strong relationship between middle years indicators and learning outcomes is largely independent of DV status at school entry suggesting that problems in the middle years, whether emergent or not, are important risk factors for poor learning outcomes.

Appendix 1: The Childhood to Adolescence Transition Study (CATS)

Overview

CATS is conducted in metropolitan Melbourne, in the state of Victoria and is one of the first studies to systematically track children through the middle years. To date, five waves of data collection have been completed. Recruitment took place in Year 3 (when children were eight to nine years of age), allowing the transition into early puberty to be captured. The most recent wave of completed data collection occurred in Year 7, after students had transitioned to secondary school. In total, 1239 students and a parent/guardian were recruited to participate in the study and retention rates have been high (80.1% students and 69.3% parents completed questionnaires in Year 7). The study collects data from students, parents and teachers, and has also been linked with Years 3, 5 and 7 NAPLAN data.

CATS is based at the Centre for Adolescent Health at the Murdoch Children's Research Institute (MCRI), Melbourne Australia. Ethics approval has been granted by the Royal Children's Hospital Human Research Ethics Committee (HREC #31089). Permission was granted from the Victorian Department of Education and Training and the Catholic Education Office Melbourne (now called Catholic Education Melbourne) to recruit through their schools.

Project governance

A reference group for the study has been established, consisting of representatives from each of the education sectors (Government, Catholic, and Independent) as well as representatives from the pilot schools and the Melbourne Education Research Institute at the University of Melbourne, VicHealth and the Mitchell Institute. The aim of the group is to assist in the achievement of project outcomes by promoting working partnerships with the education sector and the community. It also provides an avenue for community feedback about proposed research activities, as well as the support and networking required for the promotion and implementation of the project. In more recent years, the reference group has been involved in translation and dissemination of project findings.

Recruitment

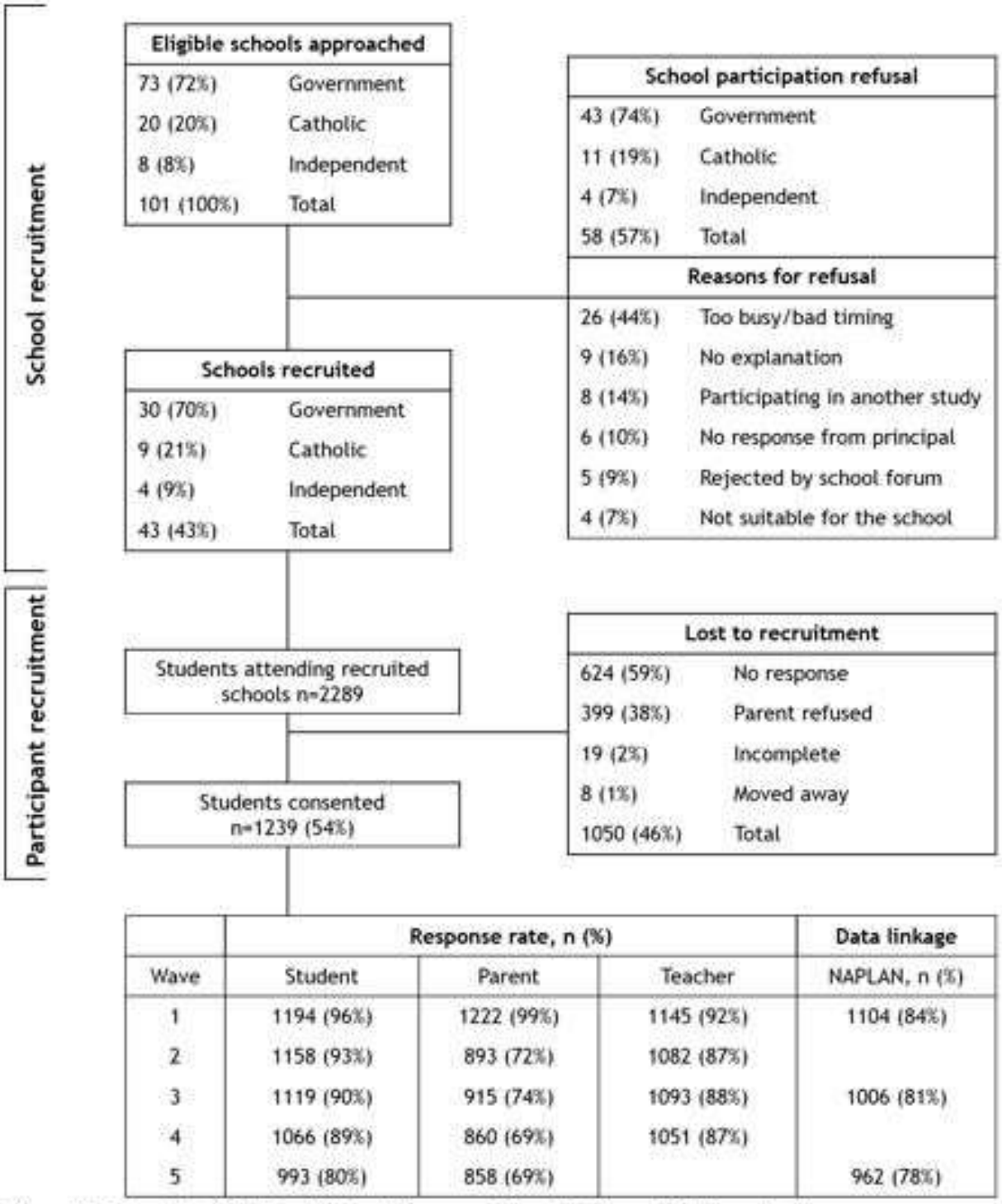
Participant recruitment commenced in February 2012. Recruitment took place through primary schools, which were randomly selected from a stratified (Government, Catholic, Independent strata) cluster sample of all such schools in metropolitan Melbourne educational regions with 10 or more students enrolled in Year 3. The metropolitan area was chosen in order to facilitate follow up assessments. School principals, at all schools, provided consent for their school's participation. If a school did not consent to take part then, where possible, a replacement school was randomly selected from the same stratum and offered participation. Figure 10 displays CATS participants from recruitment to Year 7.

The entire Year 3 year level of each participating school was invited to take part. Information sessions for students and teachers were held at all consenting schools. A recruitment pack was given to all eligible students at school to take home to their parents/guardians. Parent consent forms were then returned to the school and collected by the research team. Every child that returned a consent form (whether accepted or declined consent) was given a small prize. The class

in each school that returned the highest proportion of parent consent forms (both accepted and declined consent) was given a small prize. A total of 101 schools were approached to take part of which 43 (43%) schools agreed to participate. In total 2289 students were enrolled at these schools of which 1239 (54%) students and their parents agreed to participate. Of the students and parents who agreed to participate, 1194 (96%) students and 1222 (99%) parents took part in Wave 1 data collection. Figure 10 summarises recruitment through to Wave 5 data collection. During primary school, when three or more students participating in CATS moved to a new school, this school was invited to take part in CATS (with only the original CATS students continuing to take part). Between Waves 1 and 4, an additional nine schools were recruited into the study. A similar procedure was followed when participants commenced secondary school in 2016. Secondary schools with ten or more participants enrolled were invited to participate in the CATS study. School principals provided consent for their school to take part. All of the 37 secondary schools approached agreed to participate in the study. A small percentage of participants remained enrolled at their original school if the composition of the school was Prep to Year 9 or Prep to Year 12. No new participants were recruited to participate at the beginning of secondary school.

Measures

The Student Questionnaire (SQ) assessed many domains including mental and physical health, wellbeing, school experiences, peer and family relationships, media use and lifestyle. The parent questionnaire collected information on family demographics and on the child's emotional and behaviour problems, diet, physical health and pubertal development. The teacher questionnaire gathered information on the student's academic ability, absences from school, and behavioural and emotional functioning. In Waves 4 and 5, additional questions about adjustment to secondary school were included in all three surveys. Table 12 presents an overview of all measures included in CATS. The measures for indicators presented in the current report are described in further detail in the results section.



	Response rate, n (%)			Data linkage
Wave	Student	Parent	Teacher	NAPLAN, n (%)
1	1194 (96%)	1222 (99%)	1145 (92%)	1104 (84%)
2	1158 (93%)	893 (72%)	1082 (87%)	
3	1119 (90%)	915 (74%)	1093 (88%)	1006 (81%)
4	1066 (89%)	860 (69%)	1051 (87%)	
5	993 (80%)	858 (69%)		962 (78%)

Figure 10. Flowchart of CATS participants from recruitment to Wave 5 of data collection.

Table 12. Outline of measures (Waves 1-5).

Construct	Measures	Informant	Wave (number) / Age (years)				
			1 8-9	2 9-10	3 10-11	4 11-12	5 12-13
Demographics	Demographics	Parent/Child	✓	✓	✓	✓	✓
	SEIFA	SEIFA	✓	✓	✓	✓	✓
Pubertal transition	PDS/Tanner	Parent	✓	✓			
		Child			✓	✓	✓
	Saliva hormones	Child	✓		✓	✓	
	Acne rating	Child			✓	✓	✓
	Anthropometry	Child	✓	✓	✓	✓	✓
	Childhood exposures	Parent	✓				
Emotional and behavioural development	Mental health	Parent	✓	✓	✓	✓	✓
	Depression	Child	✓	✓	✓	✓	✓
	Anxiety	Child	✓	✓	✓	✓	✓
	Self-harm	Child				✓	✓
	Body image	Child	✓	✓	✓	✓	✓
	ADHD rating	Parent	✓	✓	✓	✓	✓
	Emotional control	Child			✓	✓	✓
		Parent	✓	✓			
	Conduct problems	Parent	✓	✓	✓	✓	✓
Social development	Peer relations	Child	✓	✓	✓	✓	✓
	Family management	Child	✓	✓	✓	✓	✓
Health and lifestyle	Wellbeing	Child	✓	✓	✓	✓	✓
	Functional somatic symptoms	Child	✓	✓	✓	✓	
		Parent		✓	✓	✓	✓
	Dietary patterns	Parent	✓	✓	✓		
		Child			✓	✓	✓
	Physical activity	Parent	✓	✓	✓		
		Child			✓	✓	✓
	Sleep	Parent	✓	✓	✓		
		Child	✓	✓	✓	✓	✓
	Substance use	Child	✓	✓	✓	✓	✓
	Media use	Child	✓	✓	✓	✓	✓
Academic outcomes	Academic performance	VCAA	✓		✓		✓
		Teacher	✓	✓	✓	✓	
	School engagement	Child		✓	✓	✓	✓
		Teacher	✓	✓	✓	✓	
	Transition difficulties	Child				✓	✓
		Parent				✓	✓
		Teacher				✓	

Demographic measures

Child age was calculated using date of birth and date of direct measurement at Wave 1. Age of parents at birth of a child participant was calculated by subtracting their child's date of birth from the parent's date of birth.

Family socio-economic status (SES) was assigned from small area deprivation measures calculated for home postcode using the Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD; population mean (M) = 1000, standard deviation (SD) = 100) from the Australian Bureau of Statistics census-based local neighbourhood Socio-Economic Index for Areas (SEIFA) [44].

Other demographic information such as Aboriginal Torres and Strait Islander (ATSI) status, parents' highest level of education and language spoken at home were collected from the respondents at Wave 1 through the parent survey.

Sample characteristics

Of the recruited sample, the mean age was nine years (SD: 5 months; range 7 years, 10 months - 10 years, 8 months). The recruited sample contained a slightly smaller proportion of boys (46.2%) compared with census data for eight- to nine-year old students enrolled in Year 3 across the state of Victoria in Australia (51.7% boys). This sample scored slightly higher on a measure of SES compared with the entire Australian population [44]. A higher percentage identified as ATSI compared with all Year 3 students in Victoria (4.8% vs. 0.8%). Child and family characteristics were similar for boys and girls: born in Australia (87.1% vs. 88.3%); Aboriginal Torres Strait Islander (5.6% vs. 4.2%); English main language spoken at home (84.6% vs. 84.6%). Table 13 outlines the characteristics of the participants at baseline.

Table 13. Overview of study participants at baseline.

	Boys Total N=572			Girls Total N=667			Between gender difference
	N	n	Value	N	n	Value	*p*[a]
Student							
Age in years (mean (SD))	572	-	9.0 (0.4)	667	-	9.0 (0.4)	0.27
Australian born	552	481	87.1	650	574	88.3	0.54
ATSI	553	31	5.6	647	27	4.2	0.25
Biological mother							
Australian born	396	307	77.5	466	349	74.9	0.82
Highest level of education	399			478			0.72
Less than Year 12		59	14.8		77	16.1	
Year 12		60	15.0		82	17.2	
Vocational		114	28.6		134	28.0	
Tertiary		166	41.6		185	38.7	
Biological father characteristic							
Australian born	287		68.3	329		74.5	0.09
Highest level of education	335			370			0.67
Less than Year 12		56	16.7		70	18.9	
Year 12		48	14.3		43	11.6	
Vocational		113	33.7		129	34.9	
Tertiary		118	35.2		128	34.6	
Family characteristic							
SEIFA quintile	572			667			0.13
1st quintile (most disadvantaged)		70	12.2		97	14.5	
2nd quintile		41	7.2		68	10.2	
3rd quintile		99	17.3		95	14.2	
4th quintile		168	29.4		178	26.7	
5th quintile (most advantaged)		194	33.9		229	34.3	
Language spoken at home	429			506			0.09
English only		363	84.6		428	84.6	
English and another language		10	2.3		24	4.7	
Another language only		56	13.1		54	10.7	
School characteristic							
Education sector	572			667			0.04
Government		399	69.8		494	74.1	
Catholic		152	26.6		139	20.8	
Independent		21	3.7		34	5.1	

N number of responses for item. All values are percentages unless specified.
[a]Between gender differences were tested using Chi-squared tests for categorical variables and independent-samples t tests for continuous variables

Sample maintenance

To assist with follow up, parents are asked at the start of the study to provide contact details of two additional friends or relatives. These contacts are used when required to help trace participants. At the conclusion of Wave 4 participating students and parents provided information about the secondary school enrolment and provided the contact details of students.

In an effort to maintain contact with CATS participants, thank you cards, birthday cards, newsletters and 'change of address' forms are sent at regular intervals to participants. A short video has also been created for the study with the primary aim of enhancing participant engagement: https://cats.mcri.edu.au/resources/.

Data collection

Data collection is conducted annually. Data are collected using parent, teacher and student self-report questionnaires. Additionally, students take part in anthropometric assessments (height, weight and waist circumference). During primary school, student data collection was conducted in a class setting during school hours. Students were provided with iPads on which they read the questions and completed their answers. At Waves 1 and 2, the SQ items were read aloud by a Research Assistant (RA), following a standard script. In subsequent waves students completed the survey in a class setting under the supervision of an RA who did not read out the items but was available to answer questions.

If three or more students were absent on the day of the survey a second data collection session at school was scheduled. If this was not possible, families were offered home visits or were invited to the Royal Children's Hospital or to a dedicated assessment session in local areas. If families had moved outside of metropolitan Melbourne, they were sent paper questionnaires by post along with a protocol for parent collection of the anthropometric measurements.

Wave 5 was conducted when students were in Year 7, the first year of secondary school. Now that students had moved to more than 250 secondary schools, school-based data collection was not feasible for the entire cohort. To maximise efficiencies, secondary schools with large clusters of students enrolled (i.e. ten or more) were identified, recruited and enrolled into the study. The first schools recruited had ten or more students, and once these schools were recruited, additional schools with large clusters of students (not quite ten) were identified and school-based data collection conducted.

Prior to the commencement of school data collection, all students were emailed (preferentially) or posted (if no known email address) the Wave 5 Student SQ. Reminder emails and postal packs, as well as SMS messages and phone call reminders were conducted for the following four months.

If a student had completed their SQ at home, prior to the school session, they only completed the anthropometric measures (height and weight, only). For all other students, they completed the SQ and anthropometric measures at the school data collection session.

In September, all parents (regardless of whether or not their child had completed the SQ) were sent the Parent Questionnaire (PQ) and those students who had not been seen at a school session were sent a 'DIY' home measurement kit. The kit included detailed instructions on how to measure height and weight, as well as a tape measure and a link to an online demonstration.

For all student and/or parent questionnaires not completed by November, participants were called and the questionnaire(s) was conducted by Computer Assisted Telephone Interview (CATI) by a trained RA. The student CATIs were conducted after school hours and on weekends. Parent CATIs took five minutes and were conducted at a suitable time for the parent. The PQ included questions around the child's transition to school. More detailed demographic questions were administered in Wave 1, at which point parents were asked to complete it and return it along with the consent form.

The class teachers of all participating students were invited to complete a brief paper questionnaire at each wave of data collection in primary school (Waves 1 to 4). This was a very short questionnaire, taking about two minutes per student to complete and asked questions about the student's overall academic ability, absences from school, and an overview of the student's behavioural and emotional functioning. In Wave 4, teachers also responded to the same questions as parents regarding anticipated adjustment to secondary school.

Appendix 2: Technical notes

Data linkage

In September 2017, the CATS data set (Waves 1 to 5, Years 3 to 7) was linked at the individual student level to the 2009 AEDC database. The Australian Institute of Health and Welfare (AIHW) performed the linkage of CATS and AEDC student identifiers and the AEDC data was then obtained from the Social Research Centre (SRC; Melbourne, Victoria).

Data were successfully linked for a total of 1085 of the 1239 children recruited to the CATS study (87.6%). On the 2012 (CATS wave 1; Year 3) characteristics, the linked cohort was similar to those not linked in terms of gender (54.2% versus 51.3% male). However, those linked were slightly younger (9.0 vs 9.1 years) and were from areas of greater advantage (SEIFA Index of Relative Socio-economic Advantage and Disadvantage score: 1013 vs 999).

The DV1 variable was available for n = 1042 of the CATS participants (96.0% of the n = 1085 linked CATS participants; 84.1% of the n = 1239 recruited CATS participants).

Measurements

Learning

Academic performance was assessed via linkage with the National Assessment Programme – Literacy and Numeracy (NAPLAN) in Years 3, 5 and 7. NAPLAN assesses academic performance on four domains - reading, writing, numeracy, and language conventions (spelling, grammar and punctuation). The reading and numeracy domains used in this report are the most reliable domains for measurement of academic performance. NAPLAN data were provided by the Victorian Curriculum and Assessment Authority (VCAA) for students whose parents had provided additional optional consent at recruitment for data linkage (n=1146, 93%).

NAPLAN scoring is designed to be consistent over time and is reported on a single scale. The NAPLAN tests therefore measure students' achievement gain between testing years, expressed as NAPLAN gain scores. The national report released each year by the Australian Curriculum Assessment and Reporting Authority (ACARA) [7] presents figures for cohort gains in NAPLAN scores. These are the differences between average NAPLAN scores for a given population or cohort in a certain domain. These can be two, four or six years apart.

Use of this approach to compare students' academic growth has been called into question [9]. Comparison of NAPLAN gain scores assumes that the growth (rate of increase) in NAPLAN scores occurs at a steady pace throughout the school years. This is not the case – students generally show greater gains in the earlier years of schooling compared to later years, a pattern that has been observed in assessment programs around the world. It is generally understood that students achieve larger educational milestones lower on the assessment scale compared to more subtle milestones further along the assessment scale. As a result, scaled score increases do not always reflect a student's level of relative growth. The growth in NAPLAN score between assessments therefore differs according to the initial score i.e. students with lower NAPLAN scores in the first assessment show greater gains than students with a higher starting score. This has important implications for policy makers who are using NAPLAN data to allocate resources and balance priorities.

In this report, NAPLAN Scale Scores (NSS) for numeracy and reading are converted to Equivalent Years of Learning (EYL) scores using a conversion table provided by Peter Goss at the Grattan Institute. The EYL is the year level at which a typical Australian student would be expected to achieve a given NSS. The conversion table was based on 2014 Australian national data for numeracy and reading and was generated by producing a fitted curve through the median scale score at Years 3, 5, 7 and 9. Estimates below Year 3 and above Year 9 are via interpolation and have lower accuracy. Note, CATS data for Year 3 were collected in 2012 and for Year 5 in 2014 and Year 7 in 2016. Any differences in the median scores between 2012, 2014 and 2016 will slightly impact our conversions.

School disengagement

Disengagement was assessed in Years 4 and 5 by responses to 3 items in the CATS student survey:

> Item 1 '*How much do you like school*?' (not at all = disengaged; a bit/a lot = not disengaged)
>
> Item 2 '*How much do you like your school teacher*?' (not at all = disengaged; a bit/a lot = not disengaged)
>
> Item 3 '*How often do you try your best at school*?' (never/a little = disengaged; most of the time/all of the time = not disengaged).

Subsequently, a summary measure was generated at both year levels to indicate if the student was disengaged at school. For example, in order to be classified as disengaged in Year 4 a student needed to select 'not at all' for item 1 and/or 'not at all' for item 2 and/or 'never/a little' for item 3.

In Years 6 and 7, a more comprehensive measure of student engagement was assessed via self-report on seven items adapted from the Beyond Blue "Your School" survey [45]. Students were asked the following items:

> How much do you like school?
>
> How often do you misbehave or cause trouble in class?
>
> Teachers notice when I'm doing a good job and let me know about it
>
> There's at least one teacher or other adult at this school I can talk to if I have a problem
>
> Doing well in school is important to me
>
> I feel like I belong at this school
>
> In the last year, did you deliberately skip a lesson or leave school without permission?

All items were converted so their response set was on a scale of 1 (low engagement) to 4 (high engagement). An overall scale score was derived by calculating the average of the item values if 5 or more items were completed. The Cronbach's alpha (internal consistency) for the scale was

acceptable (α=0.74 in Year 6). At each year level (Years 6 and 7), disengagement was defined as below the 15th percentile on the overall scale score.

The school disengagement indicator (Years 4 and 5) was generated to indicate if a student was disengaged from school (as described above) at neither of the two year levels, or at one or both of the year levels (1 or 2 years).

Wellbeing

Emotional problems

At each wave students completed a survey in which they were asked about symptoms of depression and anxiety.

Depressive symptoms were measured using two items adapted from the Short Mood and Feelings Questionnaire (SMFQ; 'I felt miserable and unhappy' and 'I didn't enjoy anything at all') [46], which have been shown to have reasonable validity as markers of depressive symptoms in similar age groups [47]. These items were scored on a 5-point Likert scale, ranging from 0 (never) to 4 (almost always). Items were then recoded on to a 3-point scale, (0 (not true); 1 (sometimes true); 2 (true)), to match the original scoring of the SMFQ. The sum of the two recoded items was calculated to generate a total score (ranging from 0 to 4), which was then dichotomised to generate a binary variable using the cut-point identified by Rhew and colleagues [47]: no depressive symptoms (≤1) versus depressive symptoms (>1).

Anxiety symptoms were assessed using two items selected from the Spence Children's Anxiety Scale (SCAS; 'I worry about things' and 'I feel afraid') [48]. These items were scored on a 5-point Likert scale, ranging from 0 (never), to 4 (almost always). Items were then recoded on to a 4-point scale, ranging from 0 (never) to 3 (always), to match the original scoring of the SCAS. The sum of the two recoded items was calculated to generate a total score (ranging from 0 to 6), which was then dichotomised to generate a binary variable: no anxiety symptoms (≤2) versus anxiety symptoms (>2).

A summary measure was generated at each of the waves to indicate if a student had emotional problems (depressive and/or anxiety symptoms). For example, a student with depressive symptoms at Wave 1 (but without symptoms of anxiety symptoms at Wave 1), was classified as having emotional problems at Wave 1.

The emotional problems indicator (Years 3 to 5) was generated to indicate if a student had emotional problems (as described above) at none of the three year levels, at one year level only (single episode), or at two or three year levels (persistent).

Behaviour problems

The class teachers of all participating students were asked to complete a brief questionnaire in Years 3 to 6. The following item was included in the questionnaire: 'Overall, how would you rate this child on the following: Disruptive in class'. This item was scores on a 5-point Likert scale, ranging from 1 (never) to 5 (always).

At each of the waves, responses were dichotomised to generate binary variables: 'never' or 'rarely' = no behaviour problems; 'sometimes' or 'often' or 'always' = behaviour problems present.

The behaviour problems indicator (Years 3 to 5) was generated to indicate if a student had behaviour problems (as described above) at none of the three year levels, at one year level only (single episode), or at two or three year levels (persistent).

Low subjective wellbeing

Low subjective wellbeing was measured via child self-report at each wave with selected items from the Paediatric Quality of Life-General Well-being Scale (PedsQL), a widely used brief measure of health-related quality of life [49, 50] . These items were: 'I feel happy', 'I feel good about myself', and 'I think good things will happen to me'. Items were scored on a 5-point Likert scale, ranging from 0 (never) to 4 (almost always). They were then linearly transformed to a 0-100 scale as follows: 0 = 0, 1 = 25, 2 = 50, 3 = 75, 4 = 100. A total score was generated by calculating the mean score of the three items.

A binary measure of low subjective wellbeing was generated at each wave defined as being below the 15th percentile of the total score distribution.

The low subjective wellbeing indicator (Years 3 to 5) was generated to indicate if a student had low subjective wellbeing (as described above) at none of the three year levels, at one year level only (single episode), or at two or three year levels (persistent).

Peer relationships

Peer support

At each wave the students completed a survey in which they were asked about peer friendships. The following item was included in the questionnaire: 'How many friends do you have?' This item was scored on a 3-point scale: 1 (not many), 2 (some), and 3 (lots).

At each wave, responses were dichotomised to generate a binary variable: 'not many' or 'some' = no peer support; 'lots = peer support.

The peer support indicator (Years 3 to 5) was generated to indicate if a student had peer support (as described above) at none of the three year levels, at one year level only (single episode), or at two or three year levels (persistent).

Bullying

Bullying victimisation was measured via child self-report at each wave with selected items from the Gatehouse Bullying Scale, which is a short, reliable scale for measuring bullying in schools. These items assessed physical victimisation (have you been hurt like being hit or kicked by another student in the past month?) and verbal victimisation (has anyone teased you or called you names in the past month?). Students responding 'yes' were then asked how often they had each experience (response options 'less than once a week', 'about once a week', 'most days'). In line with previous research, children were classified as 'frequently physically bullied' if they reported facing physical victimisation 'about once a week' or on 'most days'. Children were classified as 'frequently verbally bullied' if they reported being verbally victimised about 'once a week' or on 'most days'.

A summary measure was generated at each of the waves to indicate if a student had been frequently physically and/or verbally victimised. For example, a student who was frequently

verbally bullied at Wave 1 (but not frequently physically bullied at Wave 1), was classified as having been bullied at Wave 1.

The bullying indicator (Years 3 to 5) was generated to indicate if a student had been bullied (as described above) at none of the three year levels, at one year level only (single episode), or at two or three year levels (persistent).

Data analysis

Analyses were conducted using Stata software, release 15.0 [51].

Table 14 summarises the amount of observed data for key variables included in this report. Missing data were handled using multiple imputation. A total of 20 complete data sets were produced by imputing missing values using multiple imputation by chained equations and these were used for all regression analyses. Linear regression was used to impute the continuous variables, logistic regression was used to impute the binary variables, and ordinal logistic regression was used to impute the ordinal variable (child age); in each case including all other analysis variables as predictors (see Table 15 for a list of the variables included in the imputation model).

Table 14. Amount of observed data for key variables included in this report.

Learning outcomes	N (%)[a]	N (%)[b]
NAPLAN numeracy score		
Year 3	1020 (82.3)	888 (85.2)
Year 5	993 (80.1)	860 (82.4)
Year 7	943 (76.1)	821 (78.8)
NAPLAN reading score		
Year 3	1034 (83.5)	898 (86.2)
Year 5	993 (80.1)	859 (82.4)
Year 7	943 (76.1)	821 (78.8)
School disengagement		
Year 3	-	-
Year 4	1156 (93.3)	979 (94.0)
Year 5	1113 (89.8)	944 (90.6)
Year 6	1067 (86.1)	908 (87.1)
Year 7	990 (79.9)	844 (81.0)
Year 4-5 indicator	1094 (88.3)	926 (88.9)
Wellbeing: emotional problems		
Year 3	1159 (93.5)	978 (93.9)
Year 4	1122 (90.6)	955 (91.7)
Year 5	1113 (89.8)	945 (90.7)
Year 6	1057 (85.3)	899 (86.3)
Year 7	989 (79.8)	843 (80.9)
Year 3-5 indicator	1011 (81.6)	858 (82.3)
Wellbeing: behaviour problems		
Year 3	1141 (92.1)	957 (91.8)

Year 4	1077 (86.9)	907 (87.0)
Year 5	1091 (88.1)	927 (89.0)
Year 6	1057 (85.3)	906 (87.0)
Year 7	-	-
Year 3-5 indicator	968 (78.1)	817 (78.4)
Wellbeing: low subjective wellbeing		
Year 3	1163 (93.9)	980 (94.0)
Year 4	1142 (92.2)	968 (92.9)
Year 5	1113 (89.8)	944 (90.6)
Year 6	1066 (86.0)	907 (87.0)
Year 7	982 (79.3)	837 (89.9)
Year 3-5 indicator	1020 (82.3)	865 (69.8)
Peer relationships: peer support		
Year 3	1191 (96.1)	1003 (96.3)
Year 4	1154 (93.1)	978 (93.9)
Year 5	1118 (90.2)	949 (91.1)
Year 6	1067 (86.1)	908 (87.1)
Year 7	989 (79.8)	842 (80.8)
Year 3-5 indicator	1111 (89.7)	944 (90.6)
Peer relationships: bullying		
Year 3	1179 (95.2)	994 (95.4)
Year 4	1153 (93.1)	976 (93.7)
Year 5	1111 (89.7)	942 (90.4)
Year 6	1066 (86.0)	908 (87.1)
Year 7	975 (78.7)	829 (79.6)
Year 3-5 indicator	1039 (83.9)	881 (84.5)

[a] Number and percent of students with a valid response (out of the n = 1239 students recruited to CATS)
[b] Number and percent of students with a valid response (out of the n = 1042 CATS students linked with AEDC data and with data on the DV1 variable)

Table 15. List of variables included in the imputation procedure.

Variable	Type of variable
Child gender	Complete[a] (binary)
Child age (2009)	Complete[a] (ordinal)
SEIFA advantage/disadvantage quintile (2012)	Complete[a] (ordinal)
Developmental vulnerability (2009)	Imputed (binary)
NAPLAN numeracy score (Year 3)	Imputed (continuous)
NAPLAN numeracy score (Year 5)	Imputed (continuous)
NAPLAN numeracy score (Year 7)	Imputed (continuous)
NAPLAN reading score (Year 3)	Imputed (continuous)
NAPLAN reading score (Year 5)	Imputed (continuous)
NAPLAN reading score (Year 7)	Imputed (continuous)
School disengagement (Year 4)	Imputed (binary)
School disengagement (Year 5)	Imputed (binary)
School disengagement (Year 6)	Imputed (binary)
School disengagement (Year 7)	Imputed (binary)
Emotional problems (Year 3)	Imputed (binary)
Emotional problems (Year 4)	Imputed (binary)
Emotional problems (Year 5)	Imputed (binary)
Emotional problems (Year 6)	Imputed (binary)
Emotional problems (Year 7)	Imputed (binary)
Behaviour problems (Year 3)	Imputed (binary)
Behaviour problems (Year 4)	Imputed (binary)
Behaviour problems (Year 5)	Imputed (binary)
Behaviour problems (Year 6)	Imputed (binary)
Poor subjective wellbeing (Year 3)	Imputed (binary)
Poor subjective wellbeing (Year 4)	Imputed (binary)
Poor subjective wellbeing (Year 5)	Imputed (binary)
Poor subjective wellbeing (Year 6)	Imputed (binary)
Poor subjective wellbeing (Year 7)	Imputed (binary)
Peer support (Year 3)	Imputed (binary)
Peer support (Year 4)	Imputed (binary)
Peer support (Year 5)	Imputed (binary)
Peer support (Year 6)	Imputed (binary)
Peer support (Year 7)	Imputed (binary)
Bullying (Year 3)	Imputed (binary)
Bullying (Year 4)	Imputed (binary)
Bullying (Year 5)	Imputed (binary)
Bullying (Year 6)	Imputed (binary)
Bullying (Year 7)	Imputed (binary)

[a] This variable has no missing data.

Regression analyses – part one

Separate linear or logistic regression models were used to estimate associations between DV1 status and each of the outcomes listed in Table 16, below. Initially, all unadjusted models were fitted, from which unadjusted proportions or means, by DVI status, were estimated. Then, all models were adjusted for child age (measured by AEDC in 2009), child sex and SEIFA advantage/disadvantage quintile (measure in 2012 (wave 1; Year 3)), to estimate adjusted mean differences or odds ratios.

Table 16. List of outcome variables used in regression analyses - part one.

Outcome variables
NAPLAN numeracy score (each of Years 3, 5, 7)
NAPLAN reading score (each of Years 3, 5, 7)
School disengagement (each of Years 4, 5, 6, 7)
Emotional problems (each of Years 3, 4, 5, 6, 7)
Behaviour problems (each of Years 3, 4, 5, 6, 7)
Poor subjective wellbeing (each of Years 3, 4, 5, 6, 7)
Peer support (each of Years 3, 4, 5, 6, 7)
Bullying (each of Years 3, 4, 5, 6, 7)

Regression analyses – part two

Separate logistic or multinomial logistic regression models were used to estimate associations between DV1 status and each of the indicator variables listed in Table 17Table 17, below. Models were adjusted for child age (measured by AEDC in 2009), child sex and SEIFA advantage/disadvantage quintile (measure in 2012 (wave 1); Year 3), to estimate adjusted odds ratios or risk ratios.

Table 17. List of indicator variables used in regression analyses - parts two and three.

Indicator variables
School disengagement (Years 4-5 indicator)
Emotional problems (Years 3-5 indicator)
Behaviour problems (Years 3-5 indicator)
Poor subjective wellbeing (Years 3-5 indicator)
Peer support (Years 3-5 indicator)
Bullying (Years 3-5 indicator)

Regression analyses – part three

Separate logistic regression models were used to estimate associations between each of the indicator variables (listed in Table 17, above), and i) non-attainment of the Year 7 numeracy threshold, and (ii) non-attainment of the Year 7 reading threshold. Initially, models were adjusted for child age (measured by AEDC in 2009), child sex and SEIFA advantage/disadvantage quintile (measure in 2012 (wave 1); Year 3). Then, all models were further adjusted for DV1 status.

In addition, two logistic regression models were fitted to estimate the association between: i) DV1 status and non-attainment of the Year 7 numeracy threshold, and ii) DV1 status and non-attainment of the Year 7 reading threshold. Both models were adjusted for child age (measured by AEDC in 2009), child sex and SEIFA advantage/disadvantage quintile (measured in 2012 (wave 1); Year 3).

Appendix 3 - Description of AEDC domains and characteristics of the developmentally vulnerable group in the CATS sample

SECTION 1. Developmentally vulnerable on each domain

For each of the five AEDC domains, children receive a score between zero and ten, where zero is most developmentally vulnerable [2]. Cut-offs to dichotomise this distribution into developmentally vulnerable and not developmentally vulnerable groups were established by the AEDC in 2009. The cut-offs were set such that the lowest 10 percent of participants in each domain in 2009 were classified as developmentally vulnerable.

Table 18. Proportion of CATS participants that are vulnerable on each AEDC domain.

Domain	N[a]	n[b]	%[c]
Physical health and wellbeing	1042	65	6.2
Social competence	1042	71	6.8
Emotional maturity	1041	73	7.0
Language and cognition	1042	57	5.5
Communication and general knowledge	1042	81	7.8

[a] Number of CATS participants with a score for the domain
[b] Number of CATS participants developmentally vulnerable
[c] proportion of CATS participants developmentally vulnerable (of those with a score for the corresponding domain)

The proportion of vulnerable CATS participants on each domain ranged from 5.5% (*Language and Cognition*) to 7.8% (*Communication and General Knowledge)* as presented in Table 18. In the CATS cohort there were proportionally fewer vulnerable participants in every domain compared to Victoria overall [2].

SECTION 2. Developmentally vulnerable on 0, 1, 2, 3, 4 and 5 domains

The proportion of CATS participants who were vulnerable on none or any number of domains in 2009 is presented in Table 19.

Table 19. Proportion of CATS participants that are vulnerable on 0, 1, 2, 3, 4 or 5 domains.

Number of domains	n	%
0	858	82.3
1	90	8.6
2	54	5.2
3	17	1.6
4	17	1.6
5	6	0.6
1 or more	184	17.7

Overall, 17.7% of participants were developmentally vulnerable on at least one domain with almost half vulnerable on a single domain. Of the remainder, the number of vulnerable participants decreased with each additional domain on which they were vulnerable; with the exception that the same number of participants were vulnerable on three domains as on four. The proportion of

participants vulnerable on one or more domains in CATS was slightly lower than the overall proportion in Victoria (20.3%) [2].

SECTION 3. Demographic characteristics of vulnerable and non-vulnerable groups

The demographic characteristics of the developmentally vulnerable (on at least one domain) and not developmentally vulnerable on any domain groups are shown in Table 20.

Table 20. Characteristics of the developmentally vulnerable group.

	Not vulnerable n (%)	Vulnerable n (%)	Total n
Total	858 (82.3)	184 (17.7)	1,042
Gender			
Boys	360 (76.4)	111 (23.6)	571
Girls	498 (87.2)	73 (12.8)	471
Total	858 (82.3)	184 (17.7)	1,042
Indigenous status			
ATSI	41 (85.4)	7 (17.5)	966
Non-ATSI	797 (82.5)	169 (14.6)	48
Total	838 (82.6)	176 (17.4)	1,014
Language spoken at home			
English only	677 (86.2)	108 (13.8)	785
English and another language	46 (75.4)	15 (24.6)	61
Another language, no English	51 (67.1)	25 (32.9)	76
Total	774 (84.0)	148(16.0)	922
SES			
SEIFA Cat. 1 (most disadvantaged)	97 (70.8)	40 (29.2)	137
SEIFA Cat. 2	61 (71.8)	24 (28.2)	85
SEIFA Cat. 3	129 (83.8)	25 (16.2)	154
SEIFA Cat. 4	237 (85.3)	41 (14.8)	278
SEIFA Cat. 5 (most advantaged)	334 (86.1)	54 (13.9)	388
Total	858 (82.3)	184 (17.7)	1,042

Table 20 shows that a substantially greater proportion of boys were developmentally vulnerable than girls (23.6% versus 12.8%, $p<0.001$).

Participants of ATSI background had a slightly higher proportion of developmentally vulnerability participants than non-ATSI participants (17.5% versus 14.6%) although no statistical evidence of a difference was observed ($p=0.60$).

Almost a third of participants who speak no English at home were developmentally vulnerable. This proportion was greater than for participants who speak English and another language at home and was again greater than those who only speak English at home.

Differences according to SES as categorised by the Socio-Economic Indexes for Areas (SEIFA) were apparent with participants in areas with most socio-economic disadvantage having the greatest proportion of developmentally vulnerable students. The proportion of vulnerable participants decreased with each SEIFA category up to the most advantaged (SEIFA category 5). The proportion of developmentally vulnerable participants in the most advantaged areas was less than half that of participants in the most disadvantaged areas (17.7% versus 29.2%).

Patterns of vulnerability across all demographic groups were generally comparable to those seen nationally [2]. The difference in proportional vulnerability between ATSI and non-ATSI participants in the CATS cohort was substantially smaller than the national cohort but it is difficult to draw conclusions about this observation due to the relatively low numbers of ATSI participants in the CATS sample. Language spoken at home was not directly comparable with national data as the AEDC only reports child language background and proficiency. However, the pattern was consistent in that participants who spoke English only had proportionally lower vulnerability than other groups [2]. Victorian data were unavailable for comparison across demographic groups.

SECTION 4. Correlations between domains

Table 21. Spearman correlations between AEDC domains.

	Physical	Social	Emotional	Language	Comm.
Physical health and wellbeing	1.0				
Social competence	0.60	1.0			
Emotional maturity	0.44	0.76	1.0		
Language and cognition	0.49	0.56	0.42	1.0	
Communication	0.54	0.64	0.48	0.58	1.0

Spearman correlations between the AEDC domains were all positive and at least moderate strength. *Social Competence* generally showed the strongest correlations with other domains as presented in Table 21. The strongest correlation overall was between *Social Competence* and *Emotional Maturity (r=0.76)*, followed by *Social Competence* and *Communication and General Knowledge (r=0.64)*. No Australian data has yet been published on correlations between AEDC domains; however, these values are consistent with findings from the Canadian EDI [35, 52].

Appendix 4 – Supplementary Results

Chapter 1

Table 22 shows the β coefficient estimates obtained from the unadjusted linear regression analyses that were performed in order to estimate mean numeracy and reading NSS at Years 3, 5 and 7 (by developmental vulnerability status) (Figures 1 & 2, Table 1).

Table 22: Mean difference (β coefficient) in numeracy and reading NSS at Years 3, 5 and 7, by developmental vulnerability status

	β coefficient[a]	95% Confidence Interval
Numeracy		
Year 3	-55.6	66.5 to -44.6
Year 5	-48.8	-59.9 to -37.6
Year 7	-49.5	-59.9 to -39.0
Reading		
Year 3	-61.4	-75.6 to -47.1
Year 5	-58.0	-70.5 to -45.5
Year 7	-47.5	-58.5 to -36.4

[a] mean difference in NSS between those with developmental vulnerabilities, and those without.

Chapter 2

Table 23 shows the Odds Ratios obtained from the unadjusted logistic regression analyses that were performed in order to estimate proportions of students disengaged from school at Years 4, 5, 6 and 7 (by developmental vulnerability status) (Figure 7).

Table 23: Likelihood of student disengagement in Year 4, 5, 6 and 7 associated with developmental vulnerability status (unadjusted).

	Odds Ratio	95% Confidence Interval
Year 4		
Not-DV	Ref	
DV	2.32	1.42 to 3.77
Year 5		
Not-DV	Ref	
DV	1.69	1.05 to 2.70
Year 6		
Not-DV	Ref	
DV	1.34	0.84 to 2.15
Year 7		
Not-DV	Ref	
DV	1.06	0.66 to 1.71

Chapter 3

Table 24 shows the Odds Ratios obtained from the unadjusted logistic regression analyses that were performed in order to estimate proportions of students with (i) emotional problems, (ii) behaviour problems, and (ii) low subjective wellbeing, at Years 3, 4, 5, 6 and 7 (by developmental vulnerability status) (Figure 8).

Table 24: Likelihood of emotional problems/behaviour problems/low subjective wellbeing in Years 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Emotional problems		
Year 3		
Not-DV	Ref	
DV	1.79	1.30 to 2.47
Year 4		
Not-DV	Ref	
DV	1.61	1.09 to 2.37
Year 5		
Not-DV	Ref	
DV	2.12	1.48 to 3.02
Year 6		
Not-DV	Ref	
DV	1.23	0.81 to 1.86
Year 7		
Not-DV	Ref	
DV	1.19	0.81 to 1.76
Behaviour problems		
Year 3		
Not-DV	Ref	
DV	3.12	2.23 to 4.35
Year 4		
Not-DV	Ref	
DV	2.74	1.94 to 3.87
Year 5		
Not-DV	Ref	
DV	2.18	1.57 to 3.01
Year 6		
Not-DV	Ref	
DV	2.25	1.56 to 3.26
Low subjective wellbeing		
Year 3		
Not-DV	Ref	
DV	1.82	1.23 to 2.69
Year 4		
Not-DV	Ref	

DV	1.75	1.09 to 2.82
Year 5		
Not-DV	Ref	
DV	1.65	1.13 to 2.41
Year 6		
Not-DV	Ref	
DV	1.92	1.26 to 2.93
Year 7		
Not-DV	Ref	
DV	1.71	1.08 to 2.69

Chapter 4

Table 25 shows the Odds Ratios obtained from the unadjusted logistic regression analyses that were performed in order to estimate proportions of students reporting (i) peer support, and (ii) bullying, at Years 3, 4, 5, 6 and 7 (by developmental vulnerability status) (Figure 8).

Table 25: Likelihood of peer support/bullying in Years 3, 4, 5, 6 and 7 associated with developmental vulnerability status.

	Odds Ratio	95% Confidence Interval
Peer support		
Year 3		
Not-DV	Ref	
DV	0.70	0.51 to 0.98
Year 4		
Not-DV	Ref	
DV	0.74	0.52 to 1.07
Year 5		
Not-DV	Ref	
DV	0.72	0.52 to 1.00
Year 6		
Not-DV	Ref	
DV	0.76	0.54 to 1.06
Year 7		
Not-DV	Ref	
DV	0.71	0.50 to 1.01
Bullying		
Year 3		
Not-DV	Ref	
DV	1.51	1.09 to 2.09
Year 4		
Not-DV	Ref	
DV	1.37	0.98 to 1.92
Year 5		
Not-DV	Ref	
DV	1.69	1.15 to 2.49
Year 6		
Not-DV	Ref	
DV	1.14	0.69 to 1.88
Year 7		
Not-DV	Ref	
DV	1.49	0.92 to 2.42

Chapter 5

Tables for regression models predicting attainment of the Year 7 reading threshold are provided.

Table 26: Results of separate logistic regression models predicting non-attainment of the Year 7 reading threshold with predictors: DV (Step 1), middle years indicator (Step 2), and DV and middle years indicator together (Step 3).

a) Middle years indicator - school disengagement

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	3.45 (2.38-5.00)		3.28 (2.24-4.79)
School disengagement			
None		1	1
1 or 2 years		2.31 (1.57-3.39)	2.12 (1.41-3.18)

b) Middle years indicator - emotional problems

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	3.45 (2.38-5.00)		3.14 (2.16-4.57)
Emotional problems			
None		1	1
Single episode		2.37 (1.68-3.35)	2.23 (1.57-3.18)
Persistent		2.64 (1.76-3.97)	2.32 (1.53-3.54)

c) Middle years indicator - behaviour problems

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	3.45 (2.38-5.00)		3.14 (2.14-4.58)
Behaviour problems			
None		1	1
Single episode		1.19 (0.80-1.75)	1.13 (0.76-1.69)
Persistent		2.25 (1.51-3.36)	1.84 (1.20-2.82)

d) Middle years indicator - poor subjective wellbeing

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	3.45 (2.38-5.00)		3.24 (2.23-4.71)
Poor subjective wellbeing			
None		1	1
Single episode		1.85 (1.30-2.63)	1.71 (1.20-2.44)
Persistent		1.93 (1.26-2.95)	1.72 (1.11-2.66)

e) Middle years indicator - peer support

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	3.45 (2.38-5.00)		3.47 (2.40-5.02)
Peer support			
None		1	1
Single episode		1.12 (0.68-1.84)	1.18 (0.70-1.97)
Persistent		1.02 (0.67-1.56)	1.12 (0.71-1.74)

f) Middle years indicator - bullying

	Step 1	Step 2	Step 3
Developmentally vulnerable			
No	1		1
Yes	3.45 (2.38-5.00)		3.35 (2.31-4.87)
Bullying			
None		1	1
Single episode		1.31 (0.92-1.88)	1.29 (0.90-1.86)
Persistent		1.94 (1.34-2.82)	1.82 (1.24-2.69)

* adjusted for child gender, child age (at school entry), and child SEIFA advantage/disadvantage quintile (at Year 3).

DV status was strongly associated with Year 7 reading with DV students 3.45 times as likely to not reach the reading threshold (**Error! Reference source not found.**6). Disengagement (**Error! Reference source not found.**6a), emotional problems (b), persistent behaviour problems (c), poor subjective wellbeing (d) and persistent bullying (f) were each associated with higher likelihood of not attaining the reading threshold. When the DV1 variable and each middle years indicator were included in models together there was little change in the association between DV1 and reading, which is similar to the numeracy results presented previously (compare Step 3 with Step 1 in **Error! Reference source not found.**6a,b,c,d and f). Again, this suggests that the association between DV and academic failure appears to be largely independent of problems in the middle years. The associations between each middle year indicator and reading did not alter substantially when DV1 was included in the model (e.g. for emotional problems compare Step 2 and Step 3 in **Error! Reference source not found.**6b) suggesting that these associations are relatively independent of whether or not the student was vulnerable to begin with.

Appendix 5 – Acronyms and Abbreviations

ACARA - Australian Curriculum Assessment and Reporting Authority

AEDC – Australian Early Development Census

AEDI – Australian Early Development Index

ATSI – Aboriginal and Torres Strait Islander

CATS - Childhood to Adolescence Transition Study

CI – Confidence Interval

COAG – Council of Australian Governments

DV – Developmentally vulnerable

DV1 – Developmentally vulnerable in 1 or more domains

DV2 – Developmentally vulnerable in 2 or more domains

EDI – Early Development Index

EYL – Equivalent Years of Learning

IRSEAD - Index of Relative Socio-Economic Advantage and Disadvantage

NAPLAN - National Assessment Program – Literacy and Numeracy

NMS – National Minimum Standard

NSS – NAPLAN scale score

Not-DV – Not developmentally vulnerable

OECD – Organisation for Economic Co-operation and Development

OR – Odds Ratio

PedsQL - Paediatric Quality of Life General Well-Being Scale

PISA – The Programme for International Student Assessment

RA – Research assistant

RR – Risk Ratio

SCAS - Spence Children's Anxiety Scale

SD – Standard Deviation

SE – Standard Error

SEIFA - Socio-Economic Indexes for Areas

SES – Socio-economic status

SMFQ - Short Mood and Feelings Questionnaire

SQ - Student Questionnaire

TIMSS – Trends in International Mathematics and Science Study

YOP – Years of Progress

VCAA - Victorian Curriculum and Assessment Authority

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