AUSTRALIAN PRIMARY STUDENTS' IMPLICIT THEORIES OF INTELLIGENCE, ACADEMIC GOAL ORIENTATION, AND ACADEMIC ACHIEVEMENT: A PRELIMINARY STUDY TO INVESTIGATE THE IMPACT OF A MINDSET INTERVENTION.

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Abstract

The efficacy of academic mindset interventions has been demonstrated internationally and predominantly with secondary school students. Whether a mindset intervention can change the beliefs about intelligence held by Australian primary students remains unknown, as does the relationship between students' mindsets, their academic goal orientation, and academic achievement. A mindset intervention was delivered to 43 students in mixed ability grade 5 and 6 classes in a public primary school in Sydney, Australia. The intervention was evaluated with a randomised waitlist (control) design. The intervention promoted positive change in mindset beliefs compared with the control group. Mindset beliefs were positively associated with learning goals and academic achievement and negatively associated with performance approach and avoidance goals. The efficacy of the mindset intervention for changing primary students' beliefs about intelligence is discussed. Implications for the further development and evaluation of brief and scalable classroom intervention to promote positive academic cognitions and achievement outcomes are discussed.

DECLARATION

I declare that this submission is my work and that to the best of my knowledge and belief it contains no material previously published or written by another person nor material which has been accepted for the award of another degree or diploma at a University or institution of higher learning. The data that forms the basis of this submission was obtained from a single study utilising a sample of primary students from within a NSW metropolitan government school. This study was conducted with the approval of the Macquarie University Ethics Review Committee (Human Research) and New South Wales Department of Education (DoE). The respective protocol numbers for this project are 5201500758(MQ) and 2015339(DoE).

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Chapter 1

Introduction

The role of implicit beliefs about intelligence in shaping students' academic mindsets is well-documented internationally (Blackwell, Trzesniewski & Dweck, 2007; Cury, Da Fonseca, Zhan & Elliot, 2008; Donohoe, Topping & Hannah, 2012; Dweck, 2010; Dweck and Leggett, 1988; Dweck, Walton & Cohen, 2014; Nagaoka et al., 2013; Paunesku et al., 2015; Yeager & Walton, 2011;). However, there is little research on implicit theories of intelligence involving Australian school students (De Castella & Byrne, 2015; Martin, 2015; Tarbetsky, Collie & Andrew, 2016) and no existing Australian study could be located that involved an incremental theory 'mindset' intervention. There is limited knowledge about how these beliefs influence student learning and achievement in Australian educational contexts. However, the existing evidence-base offers some compelling arguments to support the case for closer examination. Particularly, students' incremental beliefs about intelligence (i.e. a growth mindset) have been found to predict higher academic results (Blackwell, et al., 2007; De Castella & Byrne, 2015; Dweck, 2010; Tarbetsky et al., 2016) and interventions that manipulate these beliefs have been shown to improve academic outcomes (Aronson, Fried & Good, 2002; Paunesku et al., 2015; Yeager & Walton, 2011).

1.1 *Implicit Theories*

Implicit theories (Kelly, 1955; Dweck, 2000) is a term used to describe how people develop personal self-theories to explain any number of events that take place in their lives. Referred to as implicit, these theories or beliefs are mostly hidden from conscious thought but have significant implications for the way people construe reality and respond to events (Martin, 2015; Dweck, 2000; Hong et al., 1999). Kelly (1955) postulated that we construct and test implicit theories (models or beliefs) of our world to predict future events, and make sense of our experiences (see also Monte & Sollod, 2005). Implicit self- theories develop through an iterative process whereby we build complex psychological schemata, that structure our thoughts and motivate our behaviour (Martin, 2015; Mickkovoska, 2010; Van Lange, Kruglanski & Higgins, 2011). In particular, parental feedback on socially normed 'good' and 'bad' behaviours is believed to form the building blocks of

a child's implicit beliefs (Heyman & Dweck, 1998). That is, over time parental feedback reinforces a child's belief system such that they internalise their 'good or bad' behaviours as enduring traits (Heyman & Dweck, 1998). These belief systems become generalised so that goodness is paired with intelligence and badness with stupidity, and so forth (Monte & Sollod, 2005). Thus, understanding implicit self-theories is critical to educational research as these beliefs can play a central role in influencing student's behaviour and attitudes across a broad range of domains including learning and achievement (Caridad Garcia-Cepero & McCoach, 2008; Mikkovoska, 2010).

1.2 *Attribution Theory*

Attribution theory also explains why people engage particular implicit self-theories (i.e. causal explanations) when making sense of their world (Weiner, 2005; see also Heider, 1958; Weiner, 2010). Attribution theory proposes that our interpretations of events are influenced by our construed reality, which is often biased by personal beliefs, rather than objective facts (Mickkovoska, 2010; Pickert, Meras & Witkow, 2014). Moreover, the attributions (i.e. causal explanations) people make, for example, our appraisal of events such as passing or failing an exam, are associated with positive or negative affect, which serves to reinforce, perpetuate, or inhibit future behaviours (Weiner, 1992). For instance, feelings of sadness following a failed exam may lead a student to explain this result in terms of a pervasive and global belief about academic incompetence (Heyman & Dweck, 1998). In turn, this may trigger further negative affect resulting in subsequent helpless behaviours in contextually similar situations (Seligman, 2012). In other words, there is a recursive process occurring whereby attributions shape emotional responses, which influence (academic) behaviours and subsequently reinforce beliefs about intelligence (Dweck & Leggett, 1998; McInerney & McInerney, 2002).

In summary, Kelly's (1955) notion of implicit theories explains how people develop global self-theories that are mostly latent from their conscious thought. These implicit theories help people to make sense of their world and play a significant role in influencing future actions. However, it is the attributions or causal explanations that people impose on their self- theories that appear to

have a limiting effect on their potential to achieve within a particular life domain such as education. In particular, depending on whether a student believes, they have the abilities or not to succeed academically can have a substantial influence on the way in which they explain and interpret learning outcomes (Weiner, 2005).

1.3 *Implicit Theories of Intelligence*

Implicit theories of intelligence are one subset of implicit theories that a person may hold to make sense of their world (Martin, 2015). This paper operationalises implicit theories of intelligence as the beliefs that students' hold about their own and others' cognitive abilities (Dweck, Chiu and Hong, 1995; Sternberg, 1985). Specifically, Dweck and Leggett's (1988) implicit theories of intelligence framework explains how students personal or self-beliefs about intelligence relate to and influence their learning motivation, goal orientation, academic behaviour, and achievement (Dweck, 2000; Jordan & Lovett, 2008; Martin, 2015). More recently, the term 'mindsets' (Dweck et al., 2014; Dweck, 2010) has been adopted in the literature to explain how some students view intelligence as fixed whereas other students believe intelligence is malleable (Nagaoka et al., 2013). Consistent with the literature this paper will refer to both implicit theories of intelligence and mindsets when discussing students' beliefs about intelligence.

Research demonstrates that these implicit beliefs about intelligence or our 'mindset' play a significant role in mediating cognition, behaviour, and affect that can significantly influence academic performance (Blackwell et al., 2007; Dweck et al. 2014; Paunesku et al., 2015; Renaud-Dube, Guay, Talbot, Taylor & Koestner, 2015). In particular, mindsets may explain why students of matched academic ability achieve significantly different outcomes on standardised learning tasks (Blackwell et al., 2007; Dweck, 2010; Dweck, 2000; Nagaoka et al. 2013; Tarbetsky et al., 2016). The conventional approach to remediating this problem has been to review what is being taught (content) and how this takes place (pedagogy), given there is substantial evidence demonstrating that pedagogy strongly influences learning outcomes (Hattie, 2003; Dweck et al. 2014). However, there is mounting evidence showing that the teacher's ability to affect academic change is influenced by the adaptive or maladaptive characteristics (e.g. mindsets) that students bring to

their learning environment (Dweck and Leggett, 1988; Nagaoka et al. 2013).

As outlined, students' implicit theories of intelligence are distinguishable (along a continuum) by the manner in which they influence task performance, goal orientation, affect, and behaviour (Blackwell et al. 2007; Dweck & Masters, 2009). At one end of the continuum, students may hold an 'Entity Theory' of intelligence also referred to as a fixed mindset (Dweck et al. 2014). Students who hold a fixed mindset tend to believe that intelligence is a static trait, something you are born with, which does not change over time despite effort. At the opposing end of the continuum, students may hold an 'Incremental Theory' of intelligence otherwise known as a growth mindset (Dweck et al. 2014). Here, students believe that their intellectual ability is malleable and subject to change over time with effort (Dweck, 2000; Dweck & Leggett, 1988). A small number of students (around 10-15%) may have an undecided mindset (Dweck, 2000) however, Blackwell et al (2007) asserts that mindsets tend to crystallise by the time students reach adolescence. Broad population-based research suggests that around 80-85% of people (adolescents and older) have either an entity (fixed) or incremental (growth) mindset (Van Lange et al., 2011).

Children's implicit theories of intelligence (central to this paper) are measured through self-report statements that elicit agreement with personal beliefs about intelligence (Dweck, 2000). These beliefs can be measured in children as young as 10 years, suggesting pre- adolescent children can sufficiently understand the scale items, and have already formulated beliefs about their learning abilities (Dweck, 2000; Smiley & Dweck, 1994). For children younger than 10 years, researchers (Brown, 2009; Champagne, 2015; Heyman & Dweck, 1998; Smiley & Dweck, 1994) have used alternate methods to measure and elicit implicit theory orientation including, parent-teacher evaluations of children using semi-structured interviews, and coding children's behaviours and verbalisations. More recently, researchers have begun to explore beliefs about intelligence in discrete academic domains such as science (Esparaz et al., 2014), whereas others (De Castella & Byrne, 2015) have begun to explore specific (person-focused) rather than general implicit theories of intelligence.

1.4 *Goal Orientation and Implicit Theories*

Achievement goal theory provides a framework to understand the motives that underlie why students' direct their effort and behaviour toward a specific, often pre-defined outcome (Ames & Archer, 1988; Locke & Latham, 2002). Research on this topic has historically focused on two contrasting goals that represent and reflect different patterns of beliefs, which result in contrasting (positive or negative) thoughts and feeling about ability (Dweck & Leggett, 1998). The literature refers to these contrasting achievement constructs as mastery and performance goals (Dweck & Leggett, 1998). The pursuit of either a mastery, or a performance goal suggests that students hold different conceptions of success, and ways in which they view themselves and the world (Ames, 1992). With mastery goals, students' believe that their efforts and the outcome relate, and consistently 'try their best', that is, focus their energies on developing new skills. With performance goals, the focus tends to be on proving one is better (or not worse) than others. These students tend to link effort with inability or failure (Dweck & Leggett, 1998).

Dweck's research (Dweck, 1995; Dweck & Leggett, 1998) on implicit theories has focused on the relations that mastery and performance goals share with incremental and entity theories to produce contrasting academic behaviours and outcomes. That is, mastery goals with their focus on the improvement of one's abilities (Elliot & Dweck, 1988; Jordan & Lovett, 2008) share a positive relationship with incremental theory endorsement (Burnette et al., 2013). Whereas, the selection of performance goals that focus on proving one's abilities tends to correlate with entity theory endorsement (Elliot & Dweck, 1988). Importantly, the relationship between goal orientation and implicit theories predicted higher and lower levels of academic achievement in a large longitudinal US study (Blackwell et al. 2007). The relationship between goal orientation, implicit theory endorsement, and academic achievement exists in recent cross-sectional Australian studies involving high school students (De Castella & Byrne, 2015; Tarbetsky et al. 2016). Specifically, these studies show that mastery goals positively correlate with incremental theory endorsement (i.e. a growth mindset) and higher reported academic achievement. However, whether this relationship exists within an Australian primary school context remains unknown.

1.5 *Explicit Intelligence vs. Implicit Theories of Intelligence*

In contextualising mindsets, it is important to differentiate between implicit and explicit self-theories of intelligence (Sternberg, 2005). Specifically, explicit theories of intelligence relate to the topic of general intelligence, which is evaluated through cognitive assessments designed to provide a measure of intellectual performance against age-based norms (Cohen & Swerdilk, 2005; Sternberg, 2005). In contrast to these general theories of intelligence, implicit theories of intelligence are concerned with lay theories of intelligence, or the common beliefs and assumptions people hold about their own and others cognitive ability (Dweck, Chiu and Hong, 1995). The present study is concerned with primary (elementary) students' lay or implicit theories of intelligence and the relationship they share with academic achievement, rather than explicit or general intelligence such as IQ. However, the view that intellectual ability or IQ is fixed remains an area of contention with Dweck's implicit theories framework (Donohoe et al., 2012). That is, general intelligence as captured by a single quotient (IQ test score), tends to remain stable over time (Cohen & Swerdilk, 2005). As such, Kristjansson (2008) argues that the research in support of the stability of general intelligence contradicts Dweck's assumption that ability is malleable and subject to change with effort. However, it is doubtful that Dweck is advocating that belief about intelligence directly affect changes in general intelligence. Rather, such beliefs may indirectly support or inhibit a student's learning potential, which is measured by tests of intelligence (Da Fonseca et al., 2007).

1.6 *Mindset Intervention Studies*

Studies have shown that incremental theory or mindset interventions can effectively alter the implicit beliefs about intelligence held by school students (Rattan, Sevani, Chugh & Dweck, 2015). In particular, these intervention programs demonstrate that students can be taught to understand that intelligence can 'grow like a muscle' in that, with persistence and effort our brains can develop more neural connections to become 'smarter' (Rattan et al., 2015). The results of these interventions include increased end of year GPA (Aronson et al., 2002), increased standardised mathematic scores (Blackwell et al., 2007), and improved academic performance for

minority students (Paunesku et al. 2015). More recently, there has been a trend to deliver these programs in a brief and 'scaled' format consisting of one or two lessons using on-line platforms and delivered to scores of students (Paunesku et al. 2015; Yeager & Walton, 2011). The rationale behind these large-scale interventions is to move beyond well-validated small scale and highly controlled educative interventions that require intensive researcher involvement. In doing so, researchers hope to address the question of whether these small proven studies will transfer to make a meaningful and scaled difference to large numbers of students and their learning outcomes (Paunesku et al. 2015). Emerging research demonstrates that mindset educative interventions are amenable and efficient at increasing academic achievement on a small scale, involving hundreds of students (Blackwell et al., 2007) and on a large scale involving thousands of students (Paunesku et al. 2015; Yeager et al., 2016). Further, the research demonstrates that irrespective of whether these intervention programs are delivered in class (Blackwell et al., 2007) or online (Paunesku et al. 2015) they are capable of increasing student's incremental theory endorsement (Rattan et al. 2015). However, the efficacy of brief mindset interventions to alter the beliefs about intelligence held by primary (elementary) students remains an area in need of further investigation.

1.7 *The context of the study*

The New South Wales (NSW) Department of Education (DoE) is the largest public education system in Australia, consisting of over 2,200 primary (elementary) and high schools. In NSW, compulsory schooling typically begins the year a child turns 6 years and continues until they turn 17 years of age. Schooling spans thirteen scholastic grades starting with Kindergarten and concluding with Grade 12, at which point students may gain entry to further education (University or College), a trade-based apprenticeship, or other employment. The first seven years of school are known as primary (elementary) school, and generally, a single teacher delivers all curriculum (subjects) to students. Primary education is completed in Grade 6, after which students' make the transition to high school at the start of Grade 7. The current study is located in a metropolitan primary school in Sydney, New South Wales and involves students who will be making their transition to high school the following year.

Across the state of NSW, irrespective of geographical location (metropolitan or rural), some communities have relatively higher or lower levels of socio-economic disadvantage (Grattan Institute, 2016; Berger & Archer, 2016). This is measured through nation-wide census data that captures essential information including average household income, parent's highest level of education, employment status, the level of disability, and access to government services (Australian Bureau of Statistics [ABS], 2011). The Index of Relative Socio-economic Disadvantage (IRSD) is a socio-economic index that summarises this information about the economic and social conditions of families across NSW relative to others (ABS, 2011). The IRSD groups communities into deciles ranging from 1 (lowest) through 10 (highest) relative to one another's level of disadvantage. Across Australia, educational outcomes tend to correlate with levels of disadvantage such that students in lower IRSD decile suburbs on average obtain lower grades compared to students of relatively higher IRSD decile suburbs (Grattan Institute, 2016; see also Berger & Archer, 2016). The current study occurs in a school situated in a community with an IRSD decile score of 1. This score places the school community in the bottom 10% of the state regarding socio-economic disadvantage.

The NSW DoE is currently undertaking significant reforms to align educational syllabi and practices with the anticipated needs of 21st-century citizens (Bialik, et al., 2015; Bialik & Fadel, 2015; Westwell, 2013). These reforms include policies and student wellbeing initiatives that align with the principles of fostering a growth mindset in learners. Table 1 illustrates the explicit language in national and state curriculum documents that reflect the principles of positive academic mindset beliefs such as 'persistence to achieve' and 'persevering in the face of setbacks.' It is notable that, these principles align the direction and focus of the current study.

Table 1

Current Australian National and State Education Policy Directions

National Policy *Example:* Melbourne Declaration of Educational Goals (MCEETYA, 2008).	**State Policy** *Example:* Student Wellbeing Framework (2015).	**Curriculum** *Example:* Personal and Social Capability (2013).
Goal Two: Students are 'creative, innovative and resourceful, and are able to solve problems… motivated to reach their full potential… have a sense of optimism about their lives' (p. 8-9).	'Cognitive wellbeing is associated with achievement and success…It is also informed by motivation and persistence to achieve. Cognitive wellbeing is important for attaining knowledge and experiencing positive learning' (p. 3).	'…involves students effectively regulating, managing and monitoring their responses, and persisting in completing tasks and overcoming obstacles. This is achieved through…delaying gratification and persevering in the face of setbacks and frustrations' (p. 8).

1.8 *Statement of the Problem*

Currently, there is limited Australian research about the role that implicit theories of intelligence or mindsets have on students' academic goals and academic achievement. Moreover, the Australian research to date has focused on the implicit beliefs about intelligence held by high school students (e.g. De Castella & Byrne, 2015; Martin, 2015; Tarbetsky et al. 2016). As such, the influence of these beliefs on Australian primary students' learning and achievement remains unknown. Also, the existing literature has tended to focus on whether or not brief mindset interventions can support high school students to increase their incremental theory endorsement (Blackwell et al. 2007; Donohoe, et al. 2012; Paunesku et al. 2015). No current published study could be located that evaluated the efficacy of a brief mindset intervention that aimed to increase primary (elementary) students' incremental theory endorsement. Relatedly, no mindset intervention studies could be located that involved an Australian school student population.

1.9 *Study Purpose and Aim*

The purpose of this study is to understand the implicit beliefs about intelligence of a sample of Australian primary school students and evaluate whether teaching an incremental

theory of intelligence can change or improve students' mindsets. Specifically, this study is interested in whether this intervention can shift previously held theories of intelligence into the incremental range or growth mindset. In addition, the present research assesses whether these beliefs are associated with academic achievement and academic goal orientation (De Castella & Byrne, 2015; Tarbetsky et al. 2016). The research questions and hypotheses of this study are:

Research Question 1. What are the beliefs about intelligence (mindsets) of an Australian sample of primary aged students?

Research Question 2 Are gender or ethnicity related to students' beliefs about intelligence?

Hypothesis 1. Student's pre-test beliefs about intelligence (mindset) scores will be positively associated with mastery-oriented (learning) goals and negatively correlated with performance-oriented (approach and avoidance) goals.

Hypothesis 2. Students' theories of intelligence will correlate with GPA scores.

Hypothesis 3. Students' in the incremental theory intervention group will have significantly higher incremental beliefs scores post-intervention than students in the control group.

Hypothesis 4. Students identified as holding an entity or undecided theory of intelligence (mindset) at pre-test, will increase their incremental beliefs score at posttest.

Research Question 3. Do student work samples show evidence that they can understand and apply the intervention concepts to learning tasks?

Chapter Two Literature Review

"A few modern philosophers assert that an individual's intelligence is a fixed quantity, a quantity which cannot be increased. We must protest and react against this brutal pessimism....With practice, training, and above all, method, we manage to increase our attention, our memory, our judgment and literally to become more intelligent than we were before".

Dr Alfred Binet (1909 as cited in Colman, 1990, p. 328)

The quote above shows that well over one hundred years ago, educational psychologists debated over whether or not students could continuously develop their abilities. These opposing views although concerned with explicit intelligence or IQ are equally relevant to the understanding of implicit intelligence, namely whether ability and achievement are fixed or malleable. Moreover, the debate on explicit intelligence provides an indication about the diverse, and multifaceted elements present within the literature on implicit theories that show how beliefs about intelligence influence students' motivation, effort, and academic achievement (Dweck, 2012; Dweck, 2008; Dweck & Leggett, 1988).

This chapter first outlines the review process applied to locate scholarly evidence relevant to the aims of this study. Next, the precursors and development of children's implicit beliefs about intelligence are discussed with a focus on the formation of these beliefs from early childhood. After that, a review of Dweck's (2000; see also Dweck and Leggett, 1988) self-theories of intelligence framework is conducted. The core elements of the framework are analysed including a) the role that learned response patterns have in developing implicit theories of intelligence and b) the relationship that goal orientations have on learning motivation and academic achievement. Following this, a review of the research literature on mindset interventions is discussed relating to school-based studies that focus on teaching students about incremental theory.

2.1 *Review process*

The identification of scholarly texts relevant to this thesis involved two phases. The first phase included reading any literature broadly relevant to the research topic. From this, key search terms, and research questions, were refined and mapped to relevant search terms in databases. In addition, the Campbell Collaboration (http://www.campbellcollaboration.org/) was also searched, but returned no matches for existing systematic reviews. The Campbell Collaboration produces rigorous systematic reviews that evaluate the effects of social interventions including those relating to educational improvement. The second phase involved a formal literature review search using the identified, research questions, terms and databases to address the research objectives. This included:

- What are implicit theories of intelligence and how do they form?
- What is the role of learning and performance goals within the self-theories framework?
- How do implicit theories interact with primary student's motivation and achievement?
- How do mindset interventions work and what are their known benefits?
- What limitations and critiques have been raised about implicit theories of intelligence?

The search strategy was conducted through PsycINFO and Education Research Complete (EBSCOhost platform) and generated 230 citations. These texts were checked for relevance (first sift), which resulted in the inclusion of 98 full texts that were saved onto an excel spreadsheet and retrieved for this paper. Grey literature[1] including unpublished post- graduate papers, education related policies, and relevant media clips were also reviewed.

2.2 *The Development of Implicit Theories of Intelligence*

What gives rise to the different beliefs that students hold about their intelligence? How is it that some students come to view intelligence as fixed and others as malleable? The effects that implicit theories of intelligence have on the learning and achievement of high school and adult

[1] Grey Literature is defined as literature, "which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers" (Saleh, Ratajeski, & Bertolet, 2014)

populations are well known (Blackwell et al. 2007; Dweck, 2014; Paunesku et al. 2015). However, there is less evidence detailing the development and influence of implicit belief about intelligence for much younger children, those aged from pre-school to upper primary (Champagne, 2015; Gunderson et al., 2013). Although self-theories of intelligence exist in children as young as six years, the impact this has on learning motivation does not seem to influence their self-concept, goal-orientation, and achievement until around age ten years and older (Brown, 2009; Hayman, Dweck & Cain, 1992; Folmer et al., 2008). That is, children aged younger than nine years tend to attribute academic outcomes solely to effort (Folmer et al. 2008; Nicholls, 1990). However, by adolescence students gradually differentiate between effort and ability until they perceive ability as a fixed capacity (Nicholls, 1990, 1984). In addition, as opposed to younger children who tend to correlate high-effort with intelligence, children older than ten years are more likely to view people that expend low-effort to complete tasks as more intelligent (Folmer et al., 2008). It is at this developmental stage when students begin to question the feedback received from significant others and integrate this within their self-theory to form part of their developing self-concept, response pattern, and explanatory style (Dweck, 2000).

Thus, although it may appear that young children (pre-adolescence) are relatively immune to the effects of failure, in comparison to teenagers, research shows that the experiences of failure and negative feedback strongly influence their motivation and behaviour (Champagne, 2015). For example, in a 5-year longitudinal study Gunderson et al. (2013) found that the amount of process praise (e.g., “good try”) parents gave to their children when they were around 2 to 3 years of age significantly predicted their children’s self-theory that intelligence is malleable at ages 7 to 8 years. In a similar study, Pomerantz and Kempner (2013) examined the effects of person praise (e.g. “you are smart”) versus process praise (e.g. “you tried hard”) delivered by mothers to their children. Their findings showed that as maternally delivered person praise increased, so too did children’s fixed theory of intelligence (Pomerantz & Kempner, 2013). Likewise, in a study involving 8- year-old children identified as being helpless, Hokoda and Fincham (1995) found that mothers of helpless children showed less positive affect and fewer mastery-orientated teaching strategies when their children experienced set-backs. Finally, research by Heyman, Gee and Giles (2003) found that

children's self-theories about intelligence correspond with different interpretations of achievement information. In that, preschoolers were found more likely to rate a child as being 'smart' who finds a task easy, compared to another child that finds the same task difficult.

In summary, these findings suggest that feedback delivered within the family, and school setting is influential in developing young children's beliefs that intelligence is malleable or fixed (Gunderson et al., 2013; Heyman et al., 2003). However, these studies do not compare results with older children and as such, it cannot be asserted that these precursors cause the beliefs about intelligence observed later in life. Nevertheless, this evidence, has led to the suggestion that interventions that modify beliefs about intelligence or mindsets should occur at the earliest practicable point at which they appear to crystallise (i.e. around 10-to-12 years of age) (Blackwell et al., 2007; Haimovitz, Wormington & Corpus, 2011; Romero et al., 2014 Yeager et al., 2014). It is also significant that this association between mindsets and academic outcomes occurs at the point of the transition to high school for many Australian students. Specifically, the coalescence of the onset of puberty and transition to high school are recognised as a challenging time when school engagement, attendance, and achievement typically decline (Eccles & Wigfield, 1997; Eccles et al., 1993; Romero et al., 2014). As such, mindset interventions that focus on directly supporting student's self-theories during the primary to high school transition may prove to be an efficient strategy to remediate against these declines.

2.3 *Response patterns: helpless and mastery-oriented*

As outlined in the previous section the development of children's implicit theories of intelligence is influenced by family and school feedback (Gunderson et al., 2013; Heyman et al. 2003), which tends to crystallise by the time students reach adolescence (Blackwell et al., 2007). Building on these precursors, the research suggests that students will develop one of two distinct response patterns that influence their interactions with future learning tasks. Namely, children will develop a helpless or a mastery-oriented response pattern that affects their beliefs about intelligence and academic behaviour (Dweck, 2014; Dweck, 2000; Dweck & Leggett, 1998).

On the one hand, the evidence demonstrates that students holding a helpless response pattern present with different verbalisations (cognitions), affects, and behaviours than those with a mastery-oriented response pattern (Dweck & Leggett, 1988). For instance, Muller and Dweck (1998) found that fifth-grade students praised for ability were more likely to develop a fixed mindset and demonstrate more helpless response patterns. Similarly, Diener and Dweck (1978) found that average ability fifth and sixth-grade students with a helpless response pattern would promptly give up on tasks as the level of difficulty increased. These children verbalised more self-denigrating comments to describe their intelligence, problem-solving ability, and memory, regardless of the proximity to previous task success (Diener & Dweck 1978). Moreover, children with a helpless response pattern tend to hold negative biasing towards task failure over task success when asked to recall performance ability (Dweck, 2000; Rickert, Meras & Witkow, 2014). In summary, when confronted by challenge and failure children with a learned helpless response pattern experience a narrowing of their thought-action repertoire. These students are more likely to ruminate on beliefs of inadequacy resulting in task avoidance, self- handicapping, and declined task performance (Rickert et al., 2014; Davis et al., 2011; Fredrickson, 2004; Hong et al., 1999; Chiu, Hong, & Dweck, 1997). As such, students with a helpless response pattern are more likely to hold an entity self-theory, one in which they believe intellectual ability is fixed and cannot be improved through increased effort (Blackwell et al., 2007; Dweck, 2000; Dweck & Leggett, 1988)

In contrast, students with a mastery-oriented response pattern, embrace challenge, maintain and adjust task regulation, and activate a broad range of strategies to overcome setbacks (Dweck, 2000; Dweck & Leggett, 1988; Muller & Dweck 1998). Specifically, students with a mastery-oriented response pattern do not view effort assigned to difficult tasks as futile, nor do they engage self-denigrating attributions to account for their failures (Seligman, 2012). Rather, challenging problems and failures are part of life and something to be mastered with increased effort (Dweck & Leggett, 1998; Rickert et al. 2014). Moreover, when engaged in challenge, these students do not demonstrate negative affect or employ task avoidance or self-handicapping strategies as seen in students with a helpless response pattern (Davis, et al., 2010; De Castella & Byrne 2015; Rickert et al. 2014). By comparison, students with a mastery-oriented response

pattern are more likely to hold an incremental self-theory or view that intellectual ability is malleable. Moreover, an incremental mindset is associated with academically adaptive behaviours such as increased self- regulatory strategies, effort, and persistence when faced with challenges and setbacks (Blackwell, et al. 2007; Rickert et al. 2014).

In summary, early learning experiences and (positive or negative) feedback foster a helpless or a mastery-response pattern. These response patterns, in turn, become an integrated aspect the child's belief-system that influences their subsequent academic behaviour. Students with a helpless response pattern are more likely to hold a fixed view of intelligence that is associated with low-effort and maladaptive educational strategies (Dweck, 2000; Rickert et al. 2014). Conversely, students with a mastery-oriented response pattern are more likely to hold a malleable view of intelligence (Dweck, 2000). These students are better able to regulate their thoughts and feelings when experiencing challenge and failure, are more likely to have adaptive self-beliefs, and improved academic performance (Da Fonseca, et al. 2008; Romero et al. 2014).

2.4 *Goal orientation: learning and performance goals*

Students that hold either a helpless or mastery response pattern view the world and themselves in vastly different ways. Each appears governed by a different implicit rule system that shapes their framework for interpreting and responding to academic tasks and failures (Blackwell et al. 2007; Martin, 2015). What distinguishes students among these variables is how these variables interact to influence the development of different self-theories of intelligence that promote different sets of academic goals (Burnette et al. 2013; Louis, 2011). Elliott and Dweck (1988) have identified the role that two contrasting goals have on developing opposing belief systems when directed towards the same academic task namely, *learning (or mastery)* and *performance goals* (see also Burnette et al. 2013).

Implicit theories research has largely applied a dichotomous model of achievement goal orientation to understand why students engage in different achievement-related behaviours (Dweck, 2000; see also Burnette et al., 2013). The early, formative implicit theories research

occurred before the current 2 x 2 (i.e. mastery and performance by approach and avoidance) framework was introduced to goal theory (Burnette et al. 2013). As such, the previous empirical focus has been directed on the relationship that *learning (or mastery)* and *performance goals* have on developing contrasting mindsets and academic behaviours (Burnette et al. 2013).

To illustrate the relationship between mindsets and academic goal orientations, Elliott and Dweck (1988) conducted research involving average ability fifth grade elementary (primary) school students. The results show that children who view academic tasks through a performance lens were focusing on proving their ability, correctly answering questions, and gaining the praise of others (Elliot & Dweck, 1988; see also Dweck, 2000). Further, students pursuing performance goals who experience failure were more likely to attribute the outcome to their innate inability (Dweck and Leggett, 1998). Research shows that these students are more likely to hold a fixed view about intelligence (Blackwell et al. 2007; Castella & Byrne, 2015; Dweck & Leggett, 1998; Hater, 1988). That is, the experience of task failure perpetuates the selection of low risk performance goals that involve proving a student's current ability over riskier learning goals that may involve failure, but result in the acquisition of new knowledge (Dweck, 2000; Jordan & Lovett, 2008).

Students who focus on mastery-oriented response patterns are more likely to pursue learning goals and are more concerned with improving their ability and figuring out new learning strategies (Elliot & Dweck, 1988; Jordan & Lovett, 2008). That is, students with a preference towards learning goals recognise they will need to expend effort, experience and overcome setbacks, and they value gaining new knowledge (Dweck, 2000; Louis, 2011; Rickert et al. 2014). Students pursuing learning goals rarely attribute failure to their innate ability; rather setbacks signal the possibility for new opportunities that require improved effort (Blackwell et al. 2007). Blackwell et al. (2007) found that a malleable view of intelligence mediated learning goals and the belief that hard work (effortful beliefs) is necessary for academic achievement. Conversely, the path analysis showed students that hold a fixed mindset about intelligence were more likely to pursue maladaptive learning strategies that are commonly associated with performance goals such as "I would try and cheat on the next test" (Blackwell et al. 2007 p. 250).

As noted both performance and mastery goal orientations have been recognised to hold avoidance and approach dimensions, with the latter 'approach' dimension considered preferable (Burnette et al. 2013; Harackiewicz et al., 2002). For instance, in one study De Castella and Byrne (2015) found a positive association between an entity (or fixed) self-theory and performance approach and avoidance goals in a sample of Australian high school students. However, no studies in the field of incremental theories of intelligence have reported on the mastery-avoidance dimension. Mastery approach goals focus one's action towards doing better than one has previously performed, whereas mastery avoidance goals focus on avoiding doing worse than one has previously performed (Burnette et al. 2013). The lack of research in this area (mastery avoidance goals) has been cited as an area of much needed future research (Burnette et al. 2013; Stevenson & Lochbaum, 2008).

It is noteworthy that recent research (Martin, 2015) has proposed that 'growth goals' (otherwise referred to as personal best goals) may have important implications for the development of growth mindsets in student populations. Specifically, Martin (2015) argues: "Growth goals are different from mastery goals under the major goal framework (Elliot, 2005; Elliot & Church, 1997) in that growth goals are focused on exceeding oneself (i.e., self- focused), whereas mastery goals tend to be focused on the task and mastery and / or learning of it" (pp. 208-209). Martin (2015) recently evaluated the relationship between growth goals and students' theories of intelligence in a sample of Australian adolescents. The results demonstrate that growth goals positively predicted incremental beliefs and negatively predicted entity beliefs. As such, Martin (2015) proposed that school-based growth goal interventions may encourage a growth mindset; although this hypothesis remains untested.

Overall, the research evidence shows that learning or mastery approach goals share a positive relationship with a malleable view of intelligence, more adaptive learning strategies, and better academic outcomes for some school students (Blackwell et al. 2007; De Castella & Byrne, 2015; Martin, 2015; Tarbetsky et al. 2016). Conversely, research shows how a preference for performance (approach and avoidance) goals correlates with a fixed mindset, increased self-handicapping, negative affect, and poorer academic outcomes (De Castella & Byrne, 2015;

Dupeyat & Marine, 2005; Dweck, 2000; Rickert et al. 2014).

The above analysis shows how students with an incremental self-theory have more adaptive academic response patterns when engaged in challenging learning tasks and prefer learning to performance goals. They tend to self-regulate their motivation and redouble their efforts rather than give-up (Jordan & Lovett, 2008). Entity self-theorists are more concerned with performance goals and tend to avoid new challenges that could improve their learning ability and achievement. Thus, the relationship between these two theories of intelligence and academic outcomes should be notably different (Dweck, 2000; Jordan & Lovett, 2008).

There is correlational evidence that highlights the positive relationship between an incremental self-theory of intelligence and student grades (Dweck et al. 2014; Walton, 2014). For instance, Henderson and Dweck (1999) assessed the theories of intelligence of students beginning high school and the relationship shared with their reported grades. The results found that over the course of the year incremental self-theorists improved their class rankings whereas entity self-theorists report grades declined. Likewise, in a large-scale study involving 978 third through eighth-grade students, Haimovitz et al. (2011) found a significant relationship between an incremental theory of intelligence and students Grade Point Average (GPA). Incremental self-theorists achieved higher grades compared to their entity self-theory peers. Similar findings have been observed in longitudinal studies. For instance, Blackwell et al. (2007) found that middle school students with an incremental theory of intelligence achieved higher math grades over a two- year period than students who viewed intelligence as fixed achieved lower math grades. This finding is noteworthy as pre-test math grades for all students were equivalent but became increasingly divergent, particularly after students transitioned to high school and the level of academic challenge increased (Blackwell et al. 2007). In a more recent longitudinal study, Romero et al. (2014) found that middle school students with an incremental theory of intelligence achieved higher GPAs over a two-year period and were more likely to select challenging math courses than students with in entity self-theory.

2.5 *Implicit Theories of Intelligence and Academic Achievement*

The relationship between students' beliefs about intelligence and academic achievement has been found in two recent Australian papers. De Castella and Byrne (2015) assessed the beliefs about intelligence held by 680 Australian high school students from mixed ability public and private schools. Consistent with the international literature, entity self-theorists reported lower overall academic grades as well as increased self-handicapping and disengagement from school (De Castella & Byrne, 2015). In the other study, Tarbetsky et al. (2016) evaluated the relationship between implicit theories of intelligence and the academic outcomes of Australian indigenous (Aboriginal) high school students. The results of their path analysis found 'a direct path from indigenous (Aboriginal) status to implicit beliefs and from implicit beliefs to achievement', (Tarbetsky et al. 2016, p. in press). In other words, indigenous (Aboriginal) high school students were more likely view intellectual ability as a fixed trait and in turn scored lower achievement grades.

However, some studies have not found a correlation between beliefs about intelligence and academic achievement. For instance, Donohoe et al. (2012) did not find a significant relationship between self-theories of intelligence and British secondary students' end of year academic grades. In a longitudinal British study, Furnham et al. (2003) found no relationship between implicit theories of intelligence and the academic performance of college students. As such, further research is needed to tease out the relationship between mindset orientation and academic achievement. In addition, aside from the cited Australian studies above, there is currently no research evaluating this relationship with younger students. The current study aims to address this limitation by assessing the relationship that beliefs about intelligence share with a sample of Australian primary students' academic achievement.

2.6 *Incremental Theory Interventions*

Over the past fifteen years, there has been increased interest in interventions capable of changing the beliefs about intelligence held by students within predominantly high school settings. Walton (2014) argues the efficacy of these interventions is based on their precision and ability to

target specific psychological processes, typically through a single brief exercise set within a real world setting (classroom). Studies involving these interventions have yielded tangible benefits in terms of increased academic achievement for low achieving and disadvantaged students (Yeager & Walton, 2011).

Building on preliminary research (see Aronson, 1999) about expandable and fixed abilities, Aronson et al. (2002) recruited college students to participate in a fictitious mentoring program to support middle school students. The study involved three one-hour sessions whereby participants were allocated to an intervention or control condition and assigned a fictitious middle school pen pal who was to act as a mentee for their advice. In the intervention condition, students wrote to their mentee explaining that the brain is like a muscle and can grow with effort, whereas in the control condition, mentors wrote to their mentee that all people are different and have intellectual strengths and weaknesses. Although pre-test beliefs about intelligence were not collected, post-test and three-month follow-up measures showed a significant increase in college student's views of intelligence that were assigned to the intervention condition. By comparison, the views about intelligence held by college mentors in the control condition decreased on average towards a fixed view of intelligence, although the change was not statistically significant. Aronson et al. (2002) also derived a GPA score from students' college transcripts. After controlling for differences in achievement between groups at baseline, the results showed that college students in the intervention condition achieved significantly higher GPAs post-intervention compared with college students in the control condition.

Following the study of Aronson et al. (2002), Blackwell et al. (2007) investigated the longitudinal impact that incremental theory manipulation has on 'real world' adolescent mathematics achievement. To do this, Blackwell et al. (2007) developed an eight-session intervention protocol that taught lessons focusing on intelligence as malleable. The control condition completed study skills lessons. The learning content was delivered in-class and addressed key ideas including the notion that the brain can 'grow like a muscle'. The results showed that students in the intervention group significantly increased their incremental theory endorsement at post-test, whereas students in the study skills control condition did not.

Moreover, at post-intervention, the downward trajectory in math achievement grades halted and marginally recovered for students in the experimental group; the math achievement decline continued for students in the study skills control group. However, one notable feature of this study is that students' pre-intervention scores already endorsed an incremental theory and thus at post-intervention continued to endorse an incremental theory. As such, it is difficult to know whether the incremental theory intervention would be capable of shifting the beliefs held about intelligence for students with an undecided or entity self-theory.

Although not a school-based study, Da Fonseca et al. (2008; See also Cury et al., 2008) evaluated the effects of a brief incremental theory manipulation on (*N* = 28) French high school children (mean age = 14.5 years) diagnosed with General Anxiety Disorder. The intervention involved evaluating pre and post-test IQ task performance following the reading of a vignette containing key information about a growth mindset, as well as images showing changes (growth) in task performance over time. The study found that inducing a growth mindset positively increased IQ test performance using the Wechsler Intelligence Scale for Children – Revised.

More recently, incremental theory interventions have moved to online delivery platforms. For example, the *Brainology* program (Mindset Works Inc., 2008- developed by Dweck and Blackwell) is a self-instructed computer-based program aimed at teaching adolescent students' mindset skills that increase incremental beliefs about intelligence. The program involves four, 40-minute modules accompanied by study tips, handouts, and quizzes. Dweck and colleagues have evaluated the efficacy of *Brainology* in a number of as yet unpublished studies involving high school students (as cited in Snipes, Fancsali & Stoker, 2012). In one study, Scottish high school students were randomly assigned to complete the *Brainology* program or to a wait-list control condition. The efficacy of *Brainology* was evaluated against pre and post reading achievement test scores. Students in the intervention group recorded significant increases in their reading achievement by an average of eight percentile points relative to students in the control condition (Paunesku, Goldman, & Dweck, n.d. as cited in Snipes, Fancsali & Stoker, 2012). In another study, American Latino middle-school students were randomly assigned to complete the *Brainology* program or to a wait-list control group. The results found that students in the

intervention group who received the *Brainology* program achieved on average a 0.21 increase to their GPA (Romero, Paunesku & Dweck, n.d. as cited in Snipes, Fancsali & Stoker, 2012). There are two notable limitations with these studies. Firstly, these papers are unpublished and as such, the complete study design and results are not available to review. In particular, pre and post beliefs about intelligence are not reported neither is there reference to follow-up evaluations regarding the maintenance of the effects of the *Brainology* program. Secondly, these papers have been developed within the context of validating a commercially available resource that includes one author who is also an owner of the program. As such, some researchers have questioned the independence of growth mindset studies and suggested further studies by independent researchers (see Donohoe et al. 2012).

In one such independent evaluation of the *Brainology* program, Donohoe, et al. (2012), measured changes to students' views about intelligence pre and post-program implementation. High school students (N = 33) were randomly assigned to complete the *Brainology* program or to a waitlist control condition. They found a significant increase in the incremental beliefs for students in the intervention condition at post-test. In a more recent independent study, Esparaz et al. (2014) evaluated the efficacy of the *Brainology* program on students' views about the malleability of science intelligence. Results based on a randomised sample (N = 80) of middle school American students found a significant increase in the belief that science intelligence is malleable.

However, similar to the Blackwell et al. (2007) study, students' pre-intervention scores in each of these independent studies already endorsed an incremental theory, and thus at post intervention continued to endorse an incremental theory. Although these results demonstrate that middle and high school student's beliefs about intelligence can change, it remains unknown whether it is possible to shift students' implicit beliefs from an undecided or entity self-theory to one that endorses an incremental self-theory. Furthermore, the Donohoe et al. (2012) study was the first to explore whether these changes in theory of intelligence were maintained. Their results showed that follow-up measures of students' implicit theories orientation at three months had returned to baseline levels and therefore were not maintained. Thus, although the existing literature has tracked changes in academic achievement over time (Blackwell et al. 2007;

Paunesku, et al. 2015) these papers have not evaluated whether students' theories of intelligence are maintained over time. As such, there remains a dearth of evidence that changes in students' beliefs about intelligence are maintained over time.

More recently, Paunesku, et al. (2015) evaluated the effect of a large-scale brief online mindset intervention on the academic performance of students identified as being 'at-risk'. This 'at-risk' status was measured against indicators developed by the Consortium for Chicago School Research that defines 'at-risk' as all students who earned an overall GPA of 2.0 or less and failed at least one core subject (Paunesku, et al. 2015). The intervention is a condensed version of Blackwell's eight-session program. This study involved 1,500 students across thirteen geographical and socio-economically diverse American high schools. Results illustrated that students who had failed one core class the semester prior subsequently earned higher grades and passed more classes compared to a control group at post-intervention. In addition, previously identified at-risk students achieved an increase in GPA by a mean of 6.4 percentage points. However, unlike previous studies, Paunesku, et al. (2015) did not report on student's pre and post beliefs about intelligence. Thus, although the intervention resulted in improved academic outcomes, it remains unclear whether the intervention was able to change students' beliefs about intelligence.

In a replication of the Paunesku et al. (2015) study, Yeager et al. (2016) evaluated the effects of a two-lesson online mindset intervention on student's GPA. The intervention, consisting of 3,676 ninth grade students was conducted at the start of the school year to coincide with the transition from middle school to high school. The intervention software randomly assigned students to the treatment or control groups and the researchers remained 'blind' to treatment groups throughout the study. The control group received information providing helpful advice about the transition to high school. In replicating prior findings (e.g., Paunesku et al. 2015), students in the intervention group benefited by an increase in GPA as well as a reduced rate of poor performance by 4 percentage points (Yeager et al., 2016). Importantly, lower performing students were found to gain the most benefit from the intervention, adding further support for the scalability and potential of mindset intervention.

In summary, these studies provide 'proof-of-concept' evidence that middle and high school students' implicit beliefs about intelligence are amenable to change following an incremental theory (or mindset) intervention. Although the evidence supports the premise that these interventions can significantly increase incremental theory endorsement, these results have been obtained from participants who hold a pre-existing incremental belief about intelligence. As such, it is unclear whether these interventions would be as effective for students who hold an entity or an undecided belief about intelligence. Furthermore, compared with research involving older students, there is little evidence to show the efficacy of such interventions for primary (elementary) school students.

2.7 Summary

Dweck's (2000) Implicit Theories of Intelligence framework is supported by a broad evidence-base spanning over 30 years (Moore & Shaughnessy, 2012). The aim of this chapter has been to review the central elements of this framework, which influence the development of students' beliefs about intelligence, and in turn, motivate their academic behaviour and learning outcomes. This chapter has outlined the influence that family (parent) and school-based feedback (positive or negative) has on the development of children's beliefs about intelligence. Next, it was discussed how different response patterns develop from feedback to sway students' decision to select easy or difficult learning tasks, as well as influence how they perceive themselves as learners. In particular, the research shows that students with a helpless response pattern are more likely to view intelligence as fixed, whereas students with a mastery response pattern tend to view intelligence as malleable. These response patterns and the implicit beliefs that correspond with them are associated with different goal orientations. That is, students with a preference towards performance goals are more likely to hold a fixed view about intelligence and select educative tasks that contain a high likelihood of success. Conversely, students oriented towards learning (mastery) goals are more likely to believe that intelligence in malleable and can change with effort. Finally, the research on incremental theory (mindset) interventions within the context of school settings was reviewed. Although a relatively new form of educative intervention, the overall results are promising. In particular, despite their brief and low-cost nature, these interventions have

significantly increased students' GPA scores and are effective with minority and at-risk populations (Blackwell et al. 2007; Paunesku et al. 2015; Yeager & Walton, 2011).

The researcher was unable to locate any published incremental theory intervention studies involving Australian primary or high school aged students. Thus, the potential benefits or limitations of this research remain unknown within an Australian context. Accordingly, building on the emerging international evidence, the primary purpose of this study is to understand the academic mindset beliefs of a sample of Australian primary school students, and evaluate whether teaching an incremental theory of intelligence can change or improve previously held theories of intelligence. In addition, the present research assesses whether these beliefs are associated with academic achievement and academic goal orientation.

Research Questions and Hypothesis

R1. What are the beliefs about intelligence (mindsets) of an Australian sample of primary aged students?

R2. Are gender or ethnicity related to students' beliefs about intelligence?

H1. Students' pre-test beliefs about intelligence (mindset) scores will be positively associated with mastery-oriented (learning) goals and negatively correlated with performance-oriented (approach and avoidance) goals.

H2. Students' theories of intelligence will correlate with GPA scores.

H3. Students in the incremental theory intervention group will have significantly higher incremental belief scores post intervention than students in the control group.

H4. Students identified as holding an entity or undecided theory of intelligence (mindset) at pre-test will increase their incremental belief scores at post intervention.

R3. Do student work samples show evidence that students can understand and apply the intervention concepts to learning tasks?

Chapter Three

Method

4.1 Study design

This study employed a randomised wait-list controlled design to assess a brief mindset intervention. The wait-list design was selected because it was reasonably anticipated, based on previous research evidence that the intervention would result in a positive outcome (see Paunesku et al. 2015; Blackwell et al. 2007; Aronson et al. 2002). It was deemed ethical to employ the wait-list design to provide the necessary control group but also enable this group of school students to later receive the intervention. Once consented, participants were randomly assigned to treatment or wait-list control conditions. Although ethical concerns have been raised about wait-list designs in clinical psychotherapeutic interventions (Devilly & McFarlane, 2009), this study was granted university ethics approval as a low risk educational intervention. For example, intervening to address the participant's psychological wellbeing or health was not the target of the intervention or an outcome of the study. Further, participants in the control condition were not at risk of harm because they received the intervention very quickly due to the brief nature of the intervention in the initial treatment group. Furthermore, concerns about the effect of 'knowing' one is in a wait list control group (Cunningham et al., 2013) were not relevant here because there was little wait-time to receive the intervention. In fact, participants were not aware they were in a 'waiting' group. Rather all children were informed that the intervention would take place in Term 4 of school. The study design has been schematically represented in Figure 1.

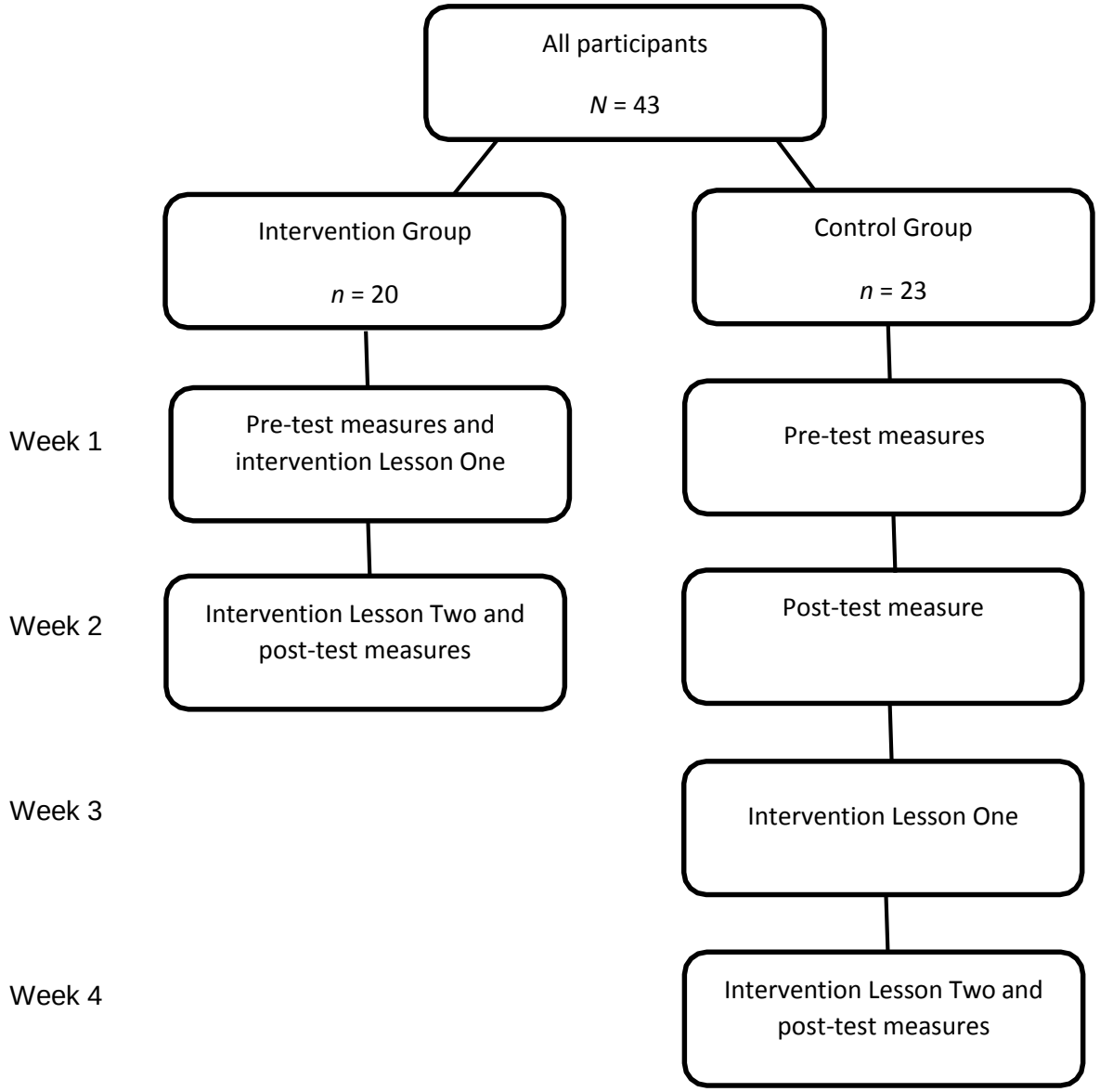


Figure 1: Study Design

4.2 Context of the study

In New South Wales, compulsory education begins from age 6 (many children commence at age 5) and continues through to the legal school leaving age of 17 years. Primary school spans seven years comprising Kindergarten to Year 6. Grades 5 and 6 are the final two years of primary school and mark a transition point to high school at around ages 11 to 12. Developmentally, this period often coincides with the onset of puberty and the period of adolescence, which is identified as a challenging time for some youth (Eccles & Wigfield, 1997). With comparison to the United States, grades 5 and 6 in Australia are equivalent to the early

years of middle school, which was the location of the Blackwell et al. (2007) mindset study.

This study took place in a South Western Sydney government primary school. This school was selected because the school adequately represented a suitable demographic for the intervention (e.g. higher risk of low academic outcomes) and the Principal of the school expressed support for an intervention of this nature. Academically, the school's results in the National Assessment Program for Literacy and Numeracy (NAPLAN) indicate mean scores below state averages for Reading and Numeracy (Annual School Report[2], 2014). The annual school report indicates that the majority of students' come from low socio-economic backgrounds and reside in a low/medium density private and social housing. Accordingly, the school receives substantial funding through the Priority School Program (PSP) from the NSW Department of Education (DoE) to assist with meeting disadvantaged students' educational needs.

All NSW Government schools are required to have a school plan that details how the learning and wellbeing needs of all students will be supported. At the study site the school's plan outlines 'high expectations for success through the development of appropriate instruction that allows for individual differences and learning styles. Our programs aim to develop active, reflective and creative life-long learners through quality teaching of the Australian curriculum.'

The student-family demographic scored in the lowest decile or bottom 10% on the Index of Relative Socio-Economic Advantage and Disadvantage (IRSD) (ABS, 2011). The IRSD is an Australian-wide robust measure of socio-economic-status that is widely used for social and educational research purposes (ABS, 2011). Further, this area has an unemployment rate that remains well above the state and national averages (ABS, 2015). Over 60% of residents report having no formal qualification and one third of residents report a family income of $266 or less per week (ABS, 2011), which is below the poverty level for a couple with 2 children (Australian Council of Social Service, 2014). Most students (91%) come from language backgrounds other than English with around 10% of students identified as English-only speaking (Annual School Report, 2014). Student attendance rates were high at over 94% for the past 5 years.

[2] Note the school's name has not been disclosed to maintain confidentiality.

4.3 Participants

Participants (*N* = 43) were grade 5 (*N* = 14) and 6 (*N* = 29) students aged 10 to 12 years (*M* = 11.11 years; SD = 0.75), representing a 29% participation rate of all students across these grades. Students reflected the typical demographic characteristics of the school and diverse academic abilities. Table 2 provides a summary of the sample characteristics.

Table 2

Demographic characteristics of the sample

Characteristic	***N***	**%**
Gender		
Female	25	58
Male	18	42
Age		
10	10	23
11	18	42
12	15	35
Culture*		
Asian	33	77
Pacifica	5	12
Middle Eastern	3	7
European	1	2
Indigenous	1	2
Grade		
5	14	33
6	29	67

* Students nominated their own cultural background on surveys: Asian refers to direct self-nomination as 'Asian' and includes student nominated nationalities like Vietnamese and Cambodian; Pacifica is an acceptable cultural identifier for peoples of the Pacific Islands and includes the countries of Samoa and New Zealand; Middle Eastern refers to those students that identified their cultural background as being from Iraq and Lebanon; European refers to responses that indicated Anglo or other European origins; Indigenous refers to students who identified as Aboriginal or Torres Strait Islander identity

4.4 Measures and Materials

Implicit theories of intelligence

Dweck's (2000) Self-theories of Intelligence Scale for Children (Appendix A) was used to determine whether students endorsed a fixed or growth mindset. This is a self-report scale that includes six statements rated on a 6-point Likert response scale where a score of 1 represents 'strongly agree' and 6 represents 'strongly disagree'. There are three incremental (growth) belief items: for example, "No matter how much intelligence you have, you can always change it quite a bit"; and three entity (fixed) belief items: for example, "Your intelligence is something about you that you can't change very much". When scoring, the incremental items are reverse coded and a mean theory of intelligence score was calculated from the six items so a higher score (6) indicated agreement with an incremental theory (or growth mindset) and lower scores (1) reflected an entity belief-system (or fixed mindset).

In keeping with the scoring procedures of Dweck (2000), scores falling below 3.0 are considered to reflect an entity theory of intelligence (fixed mindset), scores between 3.1 and 3.9 are indicative of an undecided mindset, and scores above 4.0 reflect an incremental theory of intelligence (growth mindset). The scale has been used for research with middle school students and tests of reliability have returned satisfactory results ($\alpha = 0.78$ Blackwell et al. 2007). For the current study, the internal reliability (Cronbach alpha = 0.69) of the six scale items calculated from the total scale was slightly lower than expected. Further examination of the Cronbach's alpha in the subscales revealed that the entity beliefs items had an alpha of 0.83 and incremental beliefs an alpha of 0.60 due to a low item alpha for one item. Due to the exploratory use of this scale in a single small population, it was deemed imprudent to remove any items from the scale to correct these minor deviations from more acceptable alpha levels. The full scale and all items were retained for the current study.

Academic goals

The Patterns of Adaptive Learning Scale (PALS) (Midgley et al., 2000) was used to assess students' academic goal orientation (Appendix B). This instrument was selected because it demonstrated clear and simple language deemed necessary for a mixed ability and culturally diverse cohort of learners. Other recent goal measures (e.g. Achievement Goal Questionnaire-Revised, Elliot & Murayama, 2008) contain language that is more complex or item structures more suited to higher ability learners or those in high school and therefore were not considered suitable for this study. Three self-report scales were used to assess mastery (learning) and performance (approach and avoidance) goals. Mastery goals were assessed with 5 items to assess deep learning strategies, for example, "It's important to me that I thoroughly understand my class work". Performance goals were assessed with two scales designed to assess performance approach and avoidance goals. Five items assessed performance approach goals, for example "It's important to me that other students in my class think I am good at my class work" and four items assessed avoidance goals, for example "It's important to me that I don't look stupid in class". All items on each scale were rated on a 5- point Likert scale where a score of 1 represented "Not at all true," 3 = "Somewhat true," and 5 = "Very true."

Mastery-avoidance goals were not assessed here due to theoretical and pragmatic considerations. Given the need for further research about this construct and strong correlation with performance approach goals in child studies (see Bong, 2009) it was deemed pragmatic to keep the number of survey items to a minimum and simply assess mastery approach goals in this study. Further, the assessment of mastery approach goals is consistent with previous mindset studies and thus supports suitable comparison with previous studies (e.g. Blackwell et al. 2007). In accordance with the scoring procedure of Midgley et al., (2001) a mean score was created from the items in each subscale. The PALS demonstrates good internal consistency (mastery goal scale $\alpha = 0.84$; performance approach goal scale $\alpha = 0.89$; and performance avoidance goal scale $\alpha = 0.74$, Midgley, et al. 2000) and has been widely used in research involving culturally diverse, low socio-economic and longitudinal studies, including mindset research (see e.g. Blackwell et al. 2007). Cronbach alphas for the mastery ($\alpha = 0.85$), performance approach ($\alpha = 0.73$), and

performance avoidance (α = 0.75) goal scales in the current study were acceptable

Academic Achievement

Students' annual school reports were used to represent academic achievement. In NSW public schools, educational outcomes are reported on a twice yearly student report including an achievement scale ranging from A-to-E (see Table 3 for Grade descriptors) which provides an overall measure of how well a student has performed across one semester (NSW DEC, 2006). For the present study, students' English and Math grades on these reports were averaged and converted from letter grades to Grade Point Averages (GPA), using the procedures found in existing mindset research (Paunesku et al. 2015; Rickert et al. 2014). The current sample had a mean GPA of 3.57 (SD = 0.76) which aligns with a report grade between B and C. Table 3 below illustrates the GPA conversion protocol.

Table 3

Grading Scale Conversion Table

Grade	Grade Descriptor in Annual Report	GPA
A	The student has the extensive knowledge and understanding of the content and can readily apply this knowledge	5.0
B	The student has a thorough knowledge and understanding of the content and a high level of competence in the processes and skills	4.0
C	The student has a sound knowledge and understanding of the main areas of content and has achieved an adequate level of competence in the processes and skills	3.0
D	The student has a basic knowledge and understanding of the content and has achieved a basic level of competence in the processes and skills.	2.0
E	The student has an elementary knowledge and understanding in few areas of the content and has achieved very limited competence in some of the processes and skills.	1.0

4.5 Evidence of learning in the intervention

The review of literature found little evidence and no standardised approach that explored students' recall and comprehension of study materials used in incremental theory interventions. For example, Blackwell et al. (2007) used a multiple choice test to assess comprehension of mindset concepts. Other studies (e.g. Donohoe et al. 2012; Deffer & Jolles, 2012) used student focus groups and rating scales to evaluate students' approval of the learning content they did not assess evidence of learning. To assess learning during the intervention, students' work samples will be collected and reviewed within the context of their ability to understand and apply the intervention content to learning tasks.

4.6 Procedure

This study received ethical approval from the NSW Department of Education and Macquarie University Human Research Ethics Committee (Appendix C). Parents, students and the school principal received an information letter and consent form outlining the nature and requirements of the study (Appendix D). Children were only eligible to participate in the study if both the student and their parent signed and returned the consent form (Appendix E and F). Additionally, the researcher verbally informed students about the study by reading a script outlining the nature and requirements of the study during an in-class information session, allowing students the chance to ask questions. In accordance with the ethical approval for the study, classroom teachers distributed and collected the consent forms to maintain the privacy of students in the school and minimise the possibility of direct researcher coercion. After consenting to the study, the grade coordinator assigned students to a control or intervention group using a ballot procedure that randomly selected and allocated participants from a list of consenting students.

The researcher conducted the intervention in a typical and familiar learning environment that had access to video projection equipment and adequate workspace necessary to complete the intervention activities. All students from both the intervention and wait-list control group

completed Dweck's (2000) Self-theories of Intelligence Scale for Children and the three subscales from Midgley et al's. (2000) Patterns of Adaptive Learning Scale immediately before the commencement of the first intervention trial. At the completion of the intervention, students were re-administered Dweck's (2000) Self-theories of Intelligence Scale for Children. The wait-list control group completed normal lessons as usual with their regular teachers during the first trial of the intervention and then commenced the intervention in the week following the first intervention trial. The procedures were identical. In both the intervention and wait-list group the intervention was conducted by the same person (i.e. the researcher of this project). Upon completion of the intervention for the wait list group, the researcher verbally debriefed students from both treatment groups about the nature of the study. Specifically, it was explained to students that existing research indicates that brief learning activities such as those completed in this project can help students to think differently about their intelligence and in turn, support them to achieve higher report grades. Following this, students were allowed time to ask questions, give feedback, and their work samples (i.e. post card to self) were returned. Students' final semester reports were collected several weeks after the intervention to avoid contaminating the researcher's perspective of the participating students.

4.7 The Intervention

The intervention comprised two 60 minute lessons spread over two weeks (waitlist control students participated in their regular lessons during this time). The intervention content was adapted from two previous studies shown to increase growth mindset endorsement of school-aged children (Paunesku et al. 2015; Blackwell et al. 2007). Both studies however, had some differences that needed to be addressed in the development of the current intervention. For instance, although the Blackwell et al. (2007) study involved middle-school students (some of whom would be similar in age to children in the current study), the intervention involved 8 lessons and took place over 8 weeks. The Paunesku et al. (2015) study was similar to the current study in that it also involved two lessons. However, it specifically evaluated a scaled intervention that was administered online and to high school students. As such, the current intervention was modified to include two lessons for administration in a primary school classroom context, after the

suggestions of Paunesku et al. (2015) and Walton and Yeager (2011) that brief scalable interventions show greatest promise. For example, a 'hands on' activity involving manipulating play-dough was included to help primary school students understand the key concept of 'malleability' and neuroplasticity. Similarly, the animated video 'You Can Grow Your Intelligence' (WaveTV, 2013) based on the Blackwell et al. (2007) intervention was selected to replace the video "Growing Your Mind" as used by Paunesku et al. (2015). This modification was made because the latter video contained mature adult body building themes that were not considered age appropriate or relevant for grade 5 and 6 learners. Overall, the intervention retained the face-to-face delivery format of Blackwell et al. (2007) and adopted the brief format shown to be effective in Paunesku et al., (2015). The lesson content was specifically modified to suit primary school students in the current study.

Table 4 summarises the intervention protocol and a full copy of the intervention materials are supplied in Appendix G. The lessons involved a sequence of activities designed to move students through a process of initial concrete and visual engagement with the topic deemed appropriate for their developmental stage and important to build their background knowledge and understanding. In lesson 1, students viewed stimulus materials that addressed the core concepts of a fixed and growth mindset. This was facilitated through structured hands on activities using play-dough. Next, students were guided through exploratory discussion (teacher lead group discussion), before applying their understanding to a structured written task that required more abstract thinking and personal applications (i.e. post-card to self).

In Lesson 2, students viewed addition media clips that built on their previous learning. This was supported with a teacher (researcher) led whole class concept map on the topic of neuroplasticity. Students were provided with images of neurons that depicted growth and change in brain neurons in both human and animal studies. This activity was preceded by a media clip about neuroplasticity that illustrated how the brain learns, and in turn develops new neural pathways. Thereafter, students completed the neural image activity independently on a provided template before developing their own definition of neuroplasticity. Next, students complete a worksheet that included fictional vignettes of primary students with a fixed or growth mindset. This

activity required students to write an example of how a student with a fixed mindset may respond to school related challenges, and then provide an alternate growth mindset response. Finally, students worked in pairs to develop a growth vs. fixed mindset poster that could be used to educate peers. The central theme permeating throughout the lessons was a repetitive focus on the malleability of the brain and that with effort students could change or improve their ability.

Table 4

The Intervention Protocol

Week 1	Lesson 1 summary **Hands on activity**: Students manipulate frozen and room temperature play dough to illustrate the concept of malleability **Video**: Students view the "You can grow your intelligence" (WaveTV, 2013), an animated version of the written stimulus material used in Blackwell et al. (2007) study. Depicts scientific evidence showing that our brains can change (grow) with effort. **Discussion:** Teacher facilitates a discussion of fixed vs growth mindset characteristics (class developed mind map) **Written activity**: Students write postcard to future self; offering advice to overcome a setback using a growth mindset
Week 2	Lesson 2 summary **Lesson recap and discussion**: Student lead discussion on key learning's from previous lesson supported by viewing "You can learn anything" (Khan Academy, 2014) depicting the change in learning and development as babies transition into toddlers, children, teens and young adults). **Concept map:** Researcher Introduces the concept of neuroplasticity facilitated by the video "Neuroplasticity" (Sentis, 2012). This involved selecting and describing an image of neural pathway development and a shared group discussion building collective knowledge. Students completed a concept map using the supplied template. **Responding to challenges:** Students respond to fictional vignettes that illustrate primary student with a fixed and growth mindset using the supplied worksheet. **Creative activity**: Students work in pairs to design a fixed vs. growth mindset poster aimed to educate their peers.

Chapter Four

Results

This chapter presents the main findings of the research questions and hypotheses. All statistical analyses were conducted with SPSS version 23 (IBM Corp, 2012). Prior to testing, all variables were screened for missing values and distributions of normality tested; all the proper assumptions for statistical analysis were satisfactory (Hill, 2005). Descriptive statistics for the theories of intelligence scales, motivational goals and academic achievement are shown in Table 5.

Table 5

Descriptive Statistics for Key Study Variables

Variable	**M**	**SD**
Implicit Theories of Intelligence Scale	3.87	0.86
Incremental Theory of Intelligence Scale (Growth Mindset)	4.56	1.00
Entity Theory of Intelligence Scale (Fixed Mindset)	3.18	1.26
Mastery Goal Orientation	4.29	0.77
Performance-Approach Goal Orientation	2.83	0.84
Performance-Avoidance Goal Orientation	3.00	1.10
GPA	3.57	0.78

Implicit theories of intelligence

The first research question addressed the implicit beliefs of intelligence of a sample of Australian primary aged students. Table 6 shows the number, mean, and standard deviation across the categories entity self-theory (fixed mindset), undecided, and incremental self-theory (growth mindset). Overall, the incremental theory of intelligence (growth mindset) was most frequently reported belief about intelligence, followed by an undecided theory about the malleability of intelligence. Fewer students endorsed an entity theory of intelligence.

Table 6

Implicit beliefs about intelligence

	Students (*n*)	**Mean Score**	**SD**	**Percentage (%)**
Fixed Mindset (Entity)	6	2.67	0.52	14
Undecided Mindset	18	2.67	0.52	42
Growth Mindset (Incremental)	19	2.67	0.52	44
Total	43	2.67	0.52	100

The General Linear Model univariate analysis full factorial design was employed to examine research question two, namely, whether gender or cultural background influenced students' pre-test beliefs about intelligence (baseline implicit beliefs score). With a sample size of N = 43 and with alpha set at 0.05 the interaction between these variables did not achieve significance $F(1,36) = 0.37$ $p = 0.849$. In addition, the main effect for gender was not significant $F(1,36) = 0.01$, $p = 0.791$; nor was cultural background $F(4,36) = 0.100$, $p = 0.982$. A customised model was created through the General Linear Model function to examine the interactions among the variables gender, age, ethnicity, and grade with students' implicit beliefs about intelligence set as the dependent variable. This model also failed to reach significance $F(12,30) = 0.16$ $p = 1.00$. The lack of significance found between and among these variables at pre-test suggests that at baseline, implicit beliefs for students in this study were not influenced by gender, age, cultural background, or scholastic grade.

Correlations among theory of intelligence and motivational goals

The relationships between students' theory of intelligence and motivational goals were evaluated with Pearson product-moment correlations. As shown in Table 7, theory of intelligence shared a significant and positive relationship with mastery (learning) goals. A statistically insignificant negative correlation was found between performance (approach and avoidance) goals and theories of intelligence.

Table 7

Correlations Among Theory of Intelligence and Motivational Goals

Variable	1	2	3	4
1. Theories of intelligence	-		-	-
2. Mastery Goal Orientation	0.30*	-	-	-
3 Performance-Approach Goal Orientation	-0.18	-0.05	-	-
4 Performance-Avoidance Goal Orientation	-0.06	0.07	0.51*	-

Note. * Correlation is significant at the 0.05 level (2-tailed).

Beliefs about intelligence and academic achievement

A two-tailed test of significance using Pearson product-moment correlation indicated a significant positive relationship between students' GPA and (pre-test) theory of intelligence $r(43) = 0.48$, $p < 0.001$. A one-way analysis of variance (ANOVA) with alpha set at 0.05 confirmed that students with an incremental theory of intelligence had a significantly higher grade point average (M = 3.95, SD = 0.80) than students with entity / undecided beliefs (M = 3.23, SD = 0.59), $F(1,42) = 11.249$, $p = 0.002$, $d = 1.0$). By comparison, students with a growth mindset achieved on average a school report grade equivalent to a B grade, whereas students with a fixed mindset (entity / undecided) achieved on average a C report grade.

Impact of the incremental theory intervention

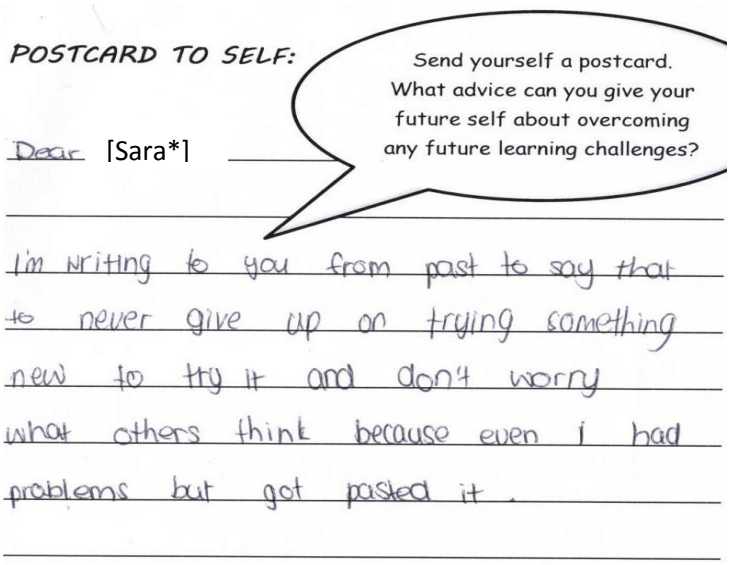
To assess whether the intervention was able to change students' theories of intelligence a, 2 (experimental vs. control) by 2 (pre-test, post-test) repeated measures analysis of variance (ANOVA) was used to assess whether the intervention and control groups differed significantly in the extent of change in their beliefs. Alpha was set at 0.05 and the analysis revealed that the experimental group endorsed an incremental theory of intelligence more strongly after participating in the intervention (pre M = 3.95, SD = 0.81 and post M = 4.60, SD = 0.90) than the control group (pre M = 3.78, SD = 0.91 and post M = 3.96, SD = 0.95), $F(1,41) = 8.51$, $p = 0.006$, $d = 0.69$. As such, on average, students in the intervention group increased their mindset scores by a little less than one full scale point (0.82) on Dweck's (1999) Implicit Theories of Intelligence Scale for Children at post-intervention. Further analysis using a repeated measures ANOVA also compared the effects of the intervention by gender and did not return a significant result $F(1,39) = 0.76$, $p = 0.39$, $d = 0.2$. (Male pre-test M = 3.7, SD = 0.76 and post-test M = 4.8, SD = 0.84 vs. Female pre-test M = 3.8, SD = 0.92 and post-test M = 4.4, SD = 0.86). These results suggest that both male and female Australian primary students in this sample experienced the same benefit from the intervention.

Change from an entity / undecided to incremental theory of intelligence

Hypothesis 4 aimed to evaluate whether or not the intervention could change the beliefs about intelligence held by students previously identified as having an undecided or entity theory. Twenty-four students with undecided or entity beliefs were identified from the intervention and wait-list control groups. Changes in students' theories of intelligence were evaluated using a paired samples *t* test with alpha set at 0.05. The results showed that on average students' theories of intelligence did change such that they endorsed an incremental theory of intelligence more strongly after participating in the intervention (M = 3.28, SD = 0.80 pre-intervention vs. M = 4.00, SD = 0.74 post-intervention, $t = -3.378$, $p = 0.003$, $d = 0.76$). A count of the number of students who changed mindset revealed that nine students of the original 24 students (38%) had moved from the entity/undecided mindset to the incremental or growth mindset category.

Learning of intervention materials

It was also of interest in the current study to evaluate the impact of the intervention materials. The researcher kept careful field notes of observed student behaviour during the intervention, particularly with use of **Research Question 1** materials and new intervention materials employed in this adaptation for primary (elementary) school students. It was noted that students showed high levels of engagement with the 'hands on' activity involving play-dough. Students were able to transfer this learning experience to class discussions about brain neuroplasticity and build upon the content shown in the video, 'You Can Grow Your Intelligence', (WaveTV, 2013). Teacher (researcher) support for individual students was minimal and consistent with the level of support that would otherwise be provided to this cohort. This consisted of clarifying any questions or repeating instructions. Students were encouraged to retain all their work at the completion of the study. Some students volunteered their work from which a purposive sample of students' work was selected from among male and female student responses resulting in four work samples in total (approximately 10% of the total sample of students). The selected examples provide evidence of learning from both the first and second lessons in the intervention. To ensure that the identities of students remain confidential a pseudonym or gender only has been used. Students were encouraged to take home all work at the completion of the study.



* The name Sara is a pseudonym in place of the student's actual name.

Figure 2. A female student's response to an activity 'Postcard to self ' from Lesson 1.

Figure 2 illustrates the activity titled ‘postcard to self’, which was completed by students in the intervention group during their first lesson. This learning activity occurred after students had viewed media and engaged in a researcher (teacher) facilitated discussion about neuroplasticity (malleability). The activity required students to generalise their new knowledge to a more abstract written task. For instance, Sara’s advice to her future self is that she should ‘never give-up’ and ‘don’t worry what others think’, demonstrating the key concepts delivered in the Lesson 1 workshop. In particular, this response shows that Sara understood the video content from ‘You can grow your intelligence’, (WaveTV, 2013) that shows how our brains can change (grow) with effort and learning through trial and error.

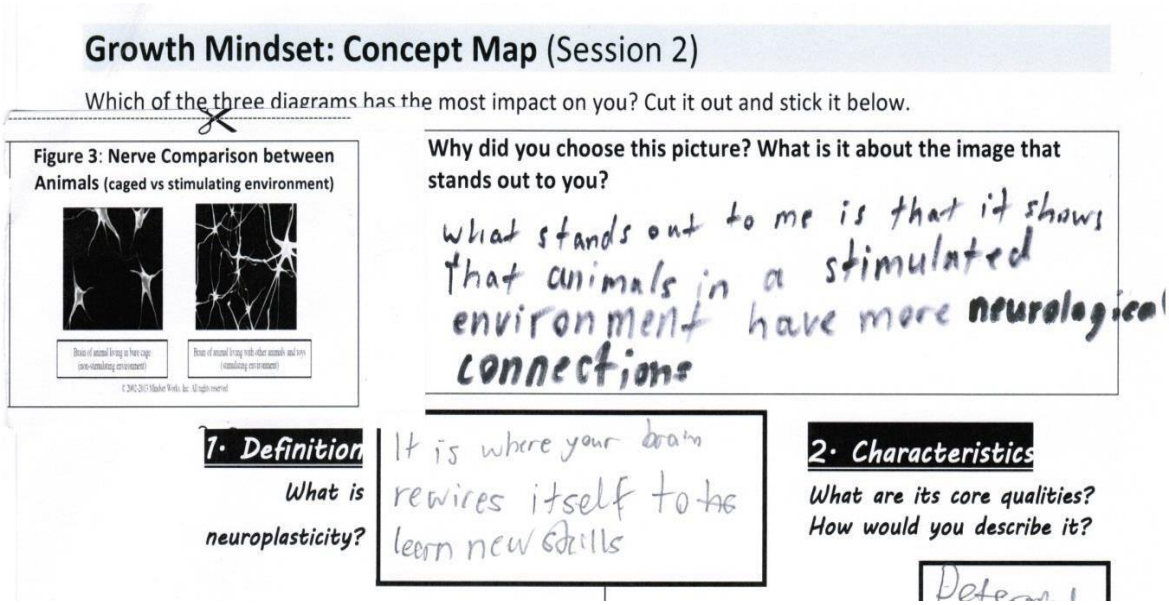


Figure 3. A male student response to the activity 'Understanding and definition of neuroplasticity' from Lesson 2.

This activity supported a teacher facilitated concept map about neuroplasticity that students completed independently using a supplied worksheet. First, students selected a single image from a series of images depicting different neural connections including animal brains or changes in a child’s brain as they develop. Next, students wrote a sentence about what was ‘personally’ significant for them in the image they had chosen. Figure 3 shows the image selected by a male student which compares the neurons of a caged animal to animal placed in a more

stimulating environment. The personal response to this image shows that the student understood how neural connections can change or ‘grow’ as a result of environmental stimulation. This was a key theme presented in the media clip “Neuroplasticity” (Sentis, 2012), which was reviewed by students prior to completing this activity.

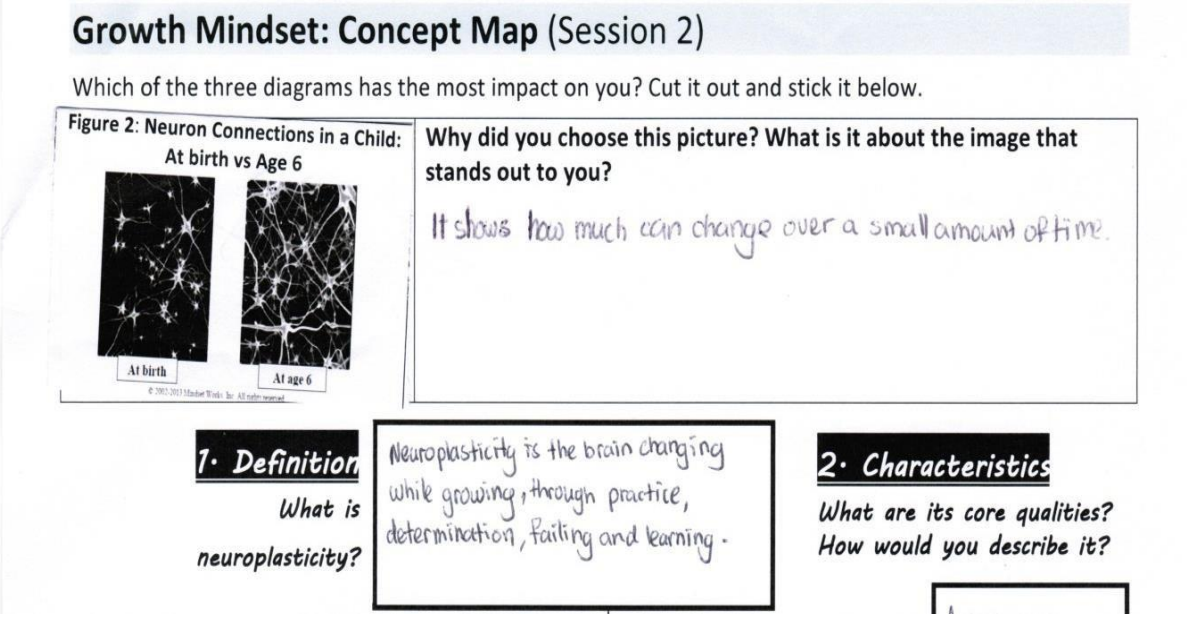
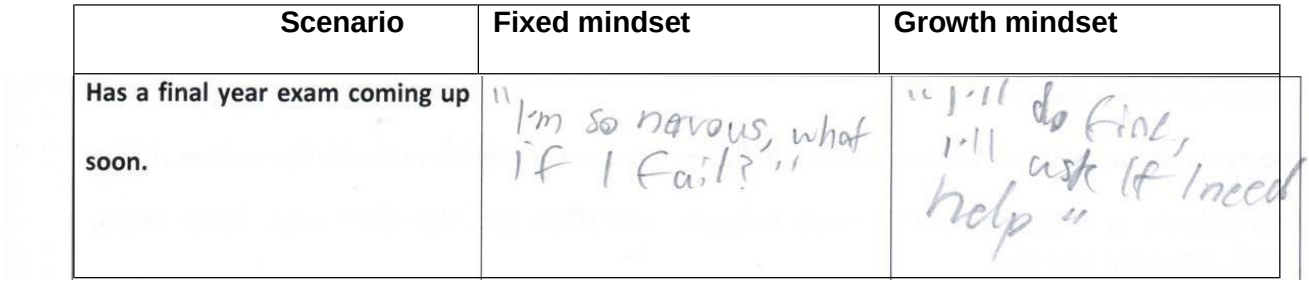


Figure 4. A female student response to the activity ' Understanding and definition of Neuroplasticity' from Lesson 2.

Figure 4 provides another example of this activity that was completed by a female student. It is interesting to note that this student has particularly noted that the brain can grow through practice and failure experiences. Importantly, these different work samples demonstrate that students understood the key themes as evidenced through their selection of different images that support their understanding of the key content. This is further evident in each student’s definition of neuroplasticity. For instance, one student has ‘picked-up’ on the idea that the brain ‘rewires itself’, whereas the other student understands neuroplasticity to mean ‘the brain changing…through practice’.

A further assessment of learning occurred through an activity that required students’ to take the perspective of a student with an entity (fixed) or incremental (growth) mindset and respond to common school related scenarios such as an upcoming exam or homework feedback.

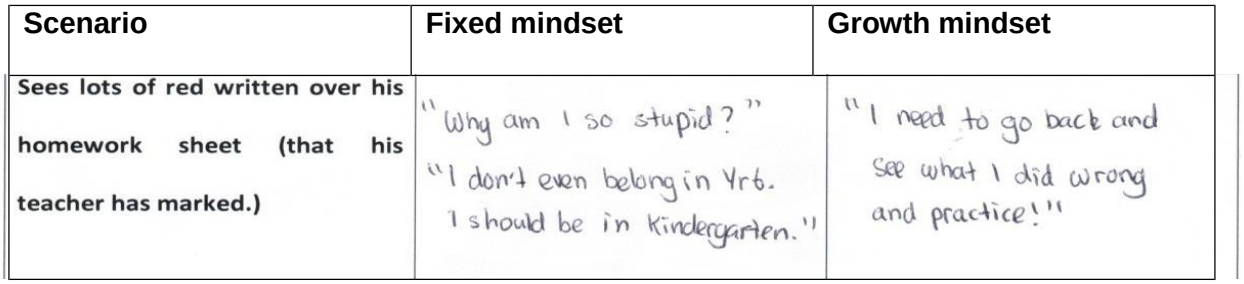
This activity occurred after all learning on Day 2 and prior to students producing a poster depicting a growth vs. fixed mindset that could be presented to a peer.



Scenario	Fixed mindset	Growth mindset
Has a final year exam coming up soon.	"I'm so nervous, what if I fail?"	"I will do fine, I will ask if I need help"

Figure 5. Male student responding to common school scenarios from the perspective of a student with a fixed and growth mindset.

As illustrated in Figure 5, the work sample demonstrates that the male student could understand the motivational behaviours and 'self-talk' of students in each mindset. Similarly, the 'Fixed mindset' example provided by a female student in Figure 6 is consistent with a helpless response pattern and the growth mindset example is consistent with a mastery- orientated response pattern using a strategy to assess 'what I did wrong'.



Scenario	Fixed mindset	Growth mindset
Sees lots of red written over his homework sheet (that his teacher has marked.)	"Why am I so stupid?" "I don't even belong in Yr6. I should be in kindergarten."	"I need to go back and see what I did wrong and practice!"

Figure 6. Female student responding to common school scenarios contrasting a fixed and growth mindset from Lesson 2.

In summary, the analysis of student work samples supports the efficacy of the intervention materials and students' ability to comprehend key intervention concepts. The statistical evaluation of the intervention provides preliminary 'proof of concept' support that a brief mindset intervention is capable of changing the beliefs about intelligence held by a sample of Australian primary students.

Chapter Five

Discussion

The aim of this study was to identify the implicit theories of intelligence held by Australian primary school students and address whether a brief mindset intervention could change these students' beliefs about intelligence. In addition, this study aimed to understand the relationships between students' mindsets and goal orientation and academic achievement (GPA). Australian primary school students endorsed undecided or entity beliefs about intelligence at a higher rate (56%) than they endorsed incremental beliefs (44%). The brief mindset intervention adapted for the Australian primary school context was effective at increasing incremental theory endorsement (i.e. a growth mindset). However, this brief cross-sectional study does not assess whether these temporary gains in mindset orientation are maintained following the intervention period. Further, the results demonstrated that, a growth mindset shares a significant and positive relationship with mastery goals. A statistically insignificant negative correlation was found between performance (approach and avoidance) goals and theories of intelligence. For students identified as holding entity or undecided beliefs, the intervention resulted in an average improvement of almost one whole scale point (0.72 points) on the Implicit Theories of Intelligence Scale for Children (Dweck, 2000). Students' beliefs about intelligence were not influenced by their gender, cultural background, age or grade level (Grade 5 or 6). Mindset was significantly related to students' academic achievement (GPA) showing that students with a growth mindset scored on average higher grades than students with a fixed mindset. Finally, evidence of student learning as demonstrated by observation and work samples shows that students could understand apply the intervention materials in a meaningful manner.

This discussion is presented in three sections. The first section examines the current research findings against the hypotheses and evaluates links with the existing research literature. The second section examines the implications and relevance to the Australian schooling context. The final section addresses research design limitations and provides recommendations for further research.

5.1 Australian primary students' theories of intelligence

The first aim of this study was to identify the implicit beliefs about intelligence held by Australian primary students. In comparison to the larger body of research on secondary school students (Blackwell et al. 2007; De Castella & Byrne, 2015; Martin, 2015; Paunesku, et al. 2015; Tarbetsky et al. 2016), little research to date has explored the beliefs of primary aged students.

The study found that this small sample of Australian primary school students endorsed incremental beliefs (44%) and undecided beliefs (42%) of intelligence at slightly higher rates than the 40:40:20 distribution (for incremental, undecided and entity beliefs, respectively) reported by Dweck (1999). While these small differences are perhaps unremarkable, and may not be representative of a larger sample of primary students, it is remarkable that this resulted in a substantially lower proportion of students endorsing entity or fixed beliefs (14%) in this sample. Although the proportion of Australian students in each category differs to the US samples, it is difficult to determine from this single study of Australian primary school students if this result would generalise to all Australian primary aged students.

Other studies in international contexts have also noted some differences in distribution of mindset beliefs. For example, British research involving gifted high school students found variations to the expected distribution, with 16% of students in the sample endorsing an entity (fixed) mindset (Cadwallader, 2009). In recently published Australian studies (De Castella & Byrne, 2015; Martin, 2015; Tarbetsky et al. 2016) the proportion of secondary students distributed across mindset categories was not provided. As such, the distribution of beliefs about intelligence for secondary students remains unclear. Future research in this area may shed light on the beliefs held by Australian secondary students and how this is distributed across different demographic populations (e.g. high and low socio- economic and educationally 'at risk').

Consistent with the screening procedures (preliminary analysis) of other studies (Paunesku et al. 2015; Romero et al. 2014; Yeager et al. 2014), students' mindsets were not related to their gender, cultural background, age, or school grade (being in years 5 or 6). This is

important because it is consistent with international research that suggests mindsets develop through learning experience rather than determined from birth (Atwood, 2010; Blackwell et al. 2007; Dweck, 2000). However, other research shows that typically, by adolescence, students' mindsets begin to crystallise, at which point, their beliefs about intelligence (malleable or fixed) can correlate with gender and age (Blackwell et al. 2007; Dweck, 2000). Moreover, it is during this developmental stage that students experience rapid biological, emotional, and academic changes. In particular, students entering high school face increasing workloads, more challenging work, and greater expectations (Yeager et al. 2014; Romero et al. 2014). As such, this period of late primary school (grades 5 and 6) and the impending transition to high school may be a pertinent intervention point for addressing student's beliefs about intelligence that can in turn, have a positive or negative influence on their academic achievement. Indeed, both small (Blackwell et al. 2007; Aaronson et al., 2002) and large (Yeager et al. 2016; Paunesku et al. 2015) mindset studies have found that carefully designed interventions that target specific psychological processes can halt academic declines and increase academic achievements for 'at risk' student populations.

5.2 The relationship between student's mindset orientation, goal preference, and GPA

Students' beliefs about intelligence, whether fixed or malleable result in different goal orientations (Dweck, 1986; Dweck & Leggett, 1988; Hong et al. 1999). Previous research (Blackwell et al. 2007; De Castella & Byrne, 2015) has shown that incremental theorists are more likely to pursue mastery goals and entity theorists, performance goals. The difference being, the former is more likely to engage in deep learning (Ames & Archer, 1988) employ deep strategies, and expand effort to overcome setbacks, whereas the latter are not (Blackwell et al. 2007; Dweck, 2000). The present study results show a positive relationship between students with an incremental theory and their endorsement of mastery (learning) goals. A recent study (De Castella & Byrne, 2015) with Australian high school students found the same relationship between incremental theory and learning goal endorsement. These results are also consistent with international findings relating to students of a similar age (Blackwell et al. 2007; Dweck &

Leggett, 1988).

The prediction that performance goals (approach and avoidance subtypes) should share a negative relationship with an incremental theory of intelligence was not supported. Other Australian research (De Castella & Byrne, 2015) involving secondary students found a significant negative relationship between entity self-theory and performance (approach and avoidance) goals. However, in contrast, other international research (Dupeyrat & Maine, 2005; O'shea et al., 2010) has found no association between mindset orientation and performances goals, or a weaker than anticipated relationship (Stipek & Gralinski, 1996).

Finally, the results uncovered an unexpected correlation between performance approach and avoidance goals. This finding has occurred in other recent Australian studies that involve implicit theories of intelligence and goal orientation (De Castella & Byrne, 2015). In addition, Berger and Archer (2016), investigating the relationship between performance (approach and avoidance) goal orientations and socio-economic disadvantage in Australian students also reported a correlation. Although it is feasible that students can hold multiple goal orientations simultaneously, the consistency of this correlation across studies has led some researchers to suggest the need to revise the performance goal framework (see Linnenbrink-Garcia et al., 2012 for a review).

A number of studies has shown that students who either have a growth mindset, or are taught to have a growth mindset, achieve better academic outcomes and out-perform their fixed mindset peers (Aronson et al. 2002; Blackwell et al. 2007; Paunesku et al. 2015; Yeager et al. 2014). However, currently there is little research investigating this relationship and none directed specifically at Australian primary students. The current study results support these international findings by showing a significant difference in GPA scores between those primary students who endorsed a growth mindset compared to those who endorsed entity or undecided mindset. In the case of the current study sample, mindset orientation did demonstrate a strong positive relationship with Australian primary students' academic achievement. Students who endorsed a growth mindset achieved an equivalent B grade, whereas students who endorsed a

fixed mindset achieve on average a C grade. By comparison, a recent Australian paper (Tarbetsky et al. 2016) that involved a sample of Australian high school students found that students' standardised mathematics and literacy achievement scores positively correlated with incremental beliefs. This study also found that Aboriginal status predicted academic achievement, when students' beliefs about intelligence were included as a mediator. The authors recommend mindset interventions as a possible avenue to close the Aboriginal and non-Aboriginal achievement gap (Tarbetsky et al. 2016). In a separate Australian study, De Castella and Byrne (2015) found that among high school students, an entity theory of intelligence correlated with lower grades, whereas an incremental theory correlated with higher grades.

5.3 The effectiveness of an Australian primary school mindset intervention

Prior research demonstrating that mindsets are amenable to teaching interventions has originated from predominantly American-based studies that typically involve high school aged students (Blackwell et al. 2007; Esparaz et al. 2014; Paunesku et al. 2015; Yeager et al. 2016). This is significant because this study is the first known Australian study to implement a mindset intervention and demonstrate that Australian primary (elementary) students can learn new ways to think about their intelligence in a naturalistic classroom setting. There is growing evidence to show that mindset interventions can enhance academic achievement, which may in turn help to close the learning achievement gap for less advantaged students (Blackwell et al. 2007; Dweck, 2014; Paunesku, et al., 2015). These findings provide a promising first step that could be built upon in future research designs.

Although US studies and similar studies (e.g. Aronson, et al. 2002; Blackwell et al. 2007; Cury et al. 2008; Donohoe et al. 2012) have demonstrated the effectiveness of mindset interventions, they have not demonstrated that such interventions can change a student's mindset belief from an entity or undecided theory to an incremental theory mindset. Rather, these studies have demonstrated increased incremental theory endorsement by students with pre-existing incremental mindsets (e.g., Aronson, et al. 2002; Blackwell, et al. 2007; Donohoe et al. 2012). This research has explicitly shown that a brief mindset intervention changed a

significant proportion (over one-third) of primary aged students from an entity or undecided mindset belief to an incremental theory endorsement. This provides evidence that a brief mindset intervention can be as effective for students in the most 'at-risk' categories of mindset beliefs as it can be for students with more positive mindsets (Blackwell et al. 2007; Paunesku et al. 2015).

In approaching the transition to high school a mindset intervention may be an effective way to protect young adolescents from the decline in academic self-beliefs that often strikes in the early years of high school (Romero et al. 2014; Yeager et al. 2014). Interventions to support student learning typically involve task differentiation or task scaffolding. However, Dweck et al. (2014) (see also Nagaoka et al. 2013) suggests the effectiveness of brief non-academic (mindset) interventions may provide another option to support and engage students in learning. In addition, these results highlight that culturally diverse and mixed ability primary aged students can understand and benefit from a mindset intervention. This builds on the already established application of mindset interventions for high school students (Blackwell et al. 2007; Paunesku et al. 2015) and provides preliminary data to support their administration to younger students who may equally benefit from the lesson content.

In summary, these results support the broader scope and applicability of mindset interventions to students who might benefit most, namely younger students on the cusp of academic transition, students with the least positive beliefs, and students from disadvantaged backgrounds. Unlike their growth mindset peers, students with a fixed mindset are perhaps more likely to avoid challenging tasks and therefore 'miss out' on learning opportunities that could improve their academic achievement (Dweck, 2014). Students from disadvantaged backgrounds are more likely to experience poor academic outcomes and disengage from school early thereby, also missing significant learning opportunities (Paunesku et al. 2015). The possibility that brief mindset interventions could act as a protective factor, increasing educational resilience for this population, is worthy of further investigation (Dweck et al. 2014; Dweck, 2010). The current results are consistent with existing international studies (Blackwell et al. 2007; Paunesku et al. 2015) in that, they support the notion that beliefs about intelligence are

not innate characteristics determined from birth. Rather, these results show that belief systems, particularly those that are problematic to learning and achievement can be manipulated through cost-effective and brief interventions that target maladaptive cognitions (Walton, 2014; Yeager & Walton, 2011).

5.4 Impact or efficacy of the intervention

To date, although in-situ, school-based mindset interventions demonstrate enhanced learning outcomes, there is less information addressing the learning and assessment of mindset intervention materials. For instance, Blackwell et al. (2007) included a multiple-choice assessment to evaluate students' knowledge and comprehension of the workshop contents at post-intervention. Overall, the intervention and treatment groups in Blackwell's study did not score significantly higher on their knowledge of general workshop content. However, the intervention group did achieve higher scores than the treatment group on items that tested incremental theory content. Notwithstanding this example, the research focus has been directed at understanding students' changes in theories of intelligence and the relationship this shares with academic goals, academic behaviours, and learning outcomes. As such, the evaluation or impact that the learning materials (intervention program) have on students' understanding of incremental theory, as demonstrated by student work samples remains unknown.

In addressing this limitation, the current study reviewed students' work samples to understand their comprehension of the intervention protocol. The selected work samples show that they could understand and explain using their own words relatively complex concepts such as neuroplasticity. Reflecting on these results, there appears to be several key themes that permeated the intervention that may help to explain the outcome. Firstly, students were provided with clear and age-relevant information about implicit theories of intelligence. This was facilitated through the use of mixed media and metaphors as a means to build content knowledge and promote deep learning. Secondly, the protocol focused on the concept of change or malleability moving forwards in time. For example, in the writing task 'post card to self', students explained (to themselves) how a growth mindset could be used to help them with challenging schoolwork or

setbacks in the future (Paunesku, et al. 2015; Yeager & Walton, 2011). This is important because research shows (Grant, 2012; Frederickson, 2004) that solution-focused and future oriented thinking strategies correlate with increased positive affect and the ability to generate more problem-solving strategies than problem-focused thinking. That is, telling and retelling (about overcoming a future obstacle, as demonstrated in the 'post-card to self' and 'responding to school scenarios' activities) may facilitate the development of new neural pathways (Rossouw, 2010). Focusing on past problems maintains existing neutral pathways (Drake, 2007; Rossouw, 2010). As such, there may be a relationship between the activities about neuroplasticity and actual changes in students' neural pathways that set in motion a recursive (growth) process (Yeager et al. 2014).

5.5 Implications and relevance to the Australian schooling context

Central to this research was a strong interest in understanding how these findings could relate to the Australian education context to improve learning outcomes and support teaching pedagogy. Thus, this section focuses on those findings that have been shown internationally to provide the greatest benefits to educational policy and practice.

Implication 1: The learning and achievement outcomes of socio-economically disadvantaged students and Aboriginal students remain problematic in Australia (Berger & Archer, 2016; PISA, 2012; Tarbetsky et al. 2016). Education plays a central role in breaking generational disadvantage and is a key protective factor that buffers against homelessness, unemployment, welfare dependency, and mental health issues (Townsend, 2012). In line with this, mindset manipulations are becoming recognised as powerful interventions capable of improving educational equality for struggling and disadvantaged students (Dweck, 2014; Dweck, 2010).

In the case of the current study, the results demonstrated that a relatively brief and inexpensive intervention could increase incremental theory endorsement for students from a school located in the bottom 10% of the Index of Relative Socio-Economic Advantage and Disadvantage (IRSD) (ABS, 2011). Internationally, similar findings have been noted for low SES

or multiple disadvantaged communities and learners. For instance, in the case of learners from a disadvantaged Native American reservation school, a school-wide approach to develop students' mindsets found that in the space of one year, students had transitioned from the bottom to leading their school district in learning achievement (Dweck, 2014). Similarly, research that targeted African-American students' beliefs about 'belonging as a learner at this school' has demonstrated sustained long-term improvements to students' academic achievement, and closed the 'racial' achievement gap by half (Yeager & Walton, 2011).

As such, it is unsurprising that a recent Australian paper recommended the use of school-based mindset interventions as a vehicle to lessen the Australian indigenous student achievement gap (Tarbetsky et al. 2016). Although the current study suggests such interventions do have positive implications for disadvantaged Australian populations, modification or culturally appropriate content considerations may be necessary for Aboriginal learners and those in other marginalised groups. Just as this intervention study had to adapt materials from a US context for an Australian, younger audience, it is conceivable that future mindset interventions could similarly adjust and develop content that is specific to the learning needs of another population. This study has effectively demonstrated that content can be mapped to the key concepts of the intervention and thus preserving the integrity and 'what works' elements of the intervention.

Implication 2: This study has also shown that mindset research and interventions are relevant and well placed within primary school settings. Importantly, these results show that by grades 5 and 6 Australian primary students may have already made up their minds as to whether they are capable learners, which will impact how they respond to future challenges and setbacks (Blackwell et al. 2007).

The current study has built on previously validated research to show that an incremental theory manipulation can be effectively administered to younger primary (elementary) aged students. This may have important implications for the Australian educative context because this period coincides with the transition from primary to high school. School transition is associated

with lower motivation and achievement outcomes for some students (Romero et al. 2014; Yeager et al. 2014) and is a time when NAPLAN results tend to decrease (Grattan Institute, 2016). These results suggest that, developmentally (cognitively), primary rather than high school may be the location in which students decide whether they have or lack the ability to succeed at school. The preliminary knowledge gained through this study may encourage future research to consider the merits of intervening earlier (i.e. at a younger age) as an avenue to enhance student academic achievement.

5.6 Limitations and future research directions

There are a number of limitations in the present study that may be addressed with future research. First, although the results were consistent with the existing international research-base, the small-scale nature of this 'proof of concept' intervention limits the generalisability of findings to the broader Australian primary school population of students. Future research should increase the sample size to increase the generalisability of findings and add depth to the limited understanding we currently have about implicit theories of intelligence within the Australian context. For instance, consideration should be given to evaluating the effectiveness of the intervention for Aboriginal and non- Aboriginal students, and students from high and low socio-economic backgrounds as suggested by others (Martin, 2015; Tarbetsky et al. 2016). This is of importance, given that evidence suggests the intervention may be effective in closing the achievement gap associated with disadvantaged student groups (Dweck, 2014).

Future research may also consider exploring the implicit beliefs about intelligence of Australian teachers (Hornstra et al. 2015). This could support school leaders and researchers to consider how the mindset of a teacher influences students. This may lead to effective whole school interventions and further research that helps us to understand the relationship between the mindset of the school, students, and teachers.

Secondly, the limitations imposed by the brief time of the current study meant the design was not longitudinal. It remains unclear whether the initial effectiveness of the intervention will be maintained. Further, it is unknown whether the intervention improved students' GPA as has

been found in international studies (Blackwell et al., 2007; Paunesku et al. 2015). Some research shows that initial increases in incremental theory endorsement following a mindset intervention are likely to return to baseline by 3- months following the intervention (Donohoe et al. 2012) whereas other studies have shown the opposite (Aronson et al. 2002). It would be beneficial to complete a future study that takes place during the primary and high school transition period and includes the collection of longitudinal data. Such a study might better support our understanding of the causal relationship between mindset orientation, the intervention effectiveness and maintenance, and its impact on students' academic achievement (see Blackwell et al., 2007 and Martin, 2015 for examples).

Thirdly, the current experimental design could be improved in future by including an active control, rather than a wait-list control. For instance, in a recent Australian study, Martin (2015) found that high school students' endorsement of growth goals had greater salience over implicit theories, rather than the reverse. However, this model, which suggests growth goal setting rather than changing students' implicit beliefs, may result in greater incremental theory endorsement has yet to be tested. A future experimental design could include a comparative evaluation between a mindset manipulation intervention and setting of growth goals. Their unique or combined effects could be evaluated on students' incremental theory endorsement and the influence this has on student's academic achievement.

Fourthly, although Cronbach's alpha for the Implicit Theories of Intelligence Scale for Children (Dweck, 2000) was lower than expect at 0.69. It was deemed imprudent to remove items in order to increase the scale's reliability based on this single small-scale study. Visual inspection showed that one incremental response item appeared to be endorsed highly by grade six female students, and with this item removed the scale's alpha did improve slightly to 0.72. However, as there are no existing Australian studies that report use of the children's scale, it is difficult to know if this variation from the expected alpha based on international studies would be maintained in a future study with a larger sample size.

Finally, there is increased interest in the 'scalability' of educative interventions including

the use of online delivery platforms, with two recent large-scale evaluations of an online mindset intervention demonstrating increased academic achievement for students at-risk of school failure (Paunesku et al. 2015; Yeager, et al. 2016). However, these studies were based on a high school sample and the applicability to primary students remains unclear. For instance, the current study aided students' understanding of the relatively abstract concepts of neuroplasticity and the 'malleability' of intelligence by incorporating a number of concrete hands-on activities. These activities would likely be lost from an online delivery method and would require careful consideration of comparative virtual tasks. However, online educative interventions are increasingly demonstrating their ability to be both effective and cost neutral, and should be considered in future research (for a cost-benefit analysis see Paunesku et al., 2015).

5.7 Conclusion

The current study aimed to understand the beliefs about intelligence held by a sample of Australian primary students. In doing so, it examined the effectiveness of a brief mindset intervention within an Australian primary setting and the relationship that students' mindsets share with their academic goals and academic achievement. The study results found that students' gender, age, scholastic grade, and culture have no bearing on the belief that intelligence is fixed or malleable. This is consistent with international findings about implicit theories and suggests that meaning systems about intelligence are learned within a social-developmental context, rather than determined from birth.

The intervention demonstrated that a brief incremental theory manipulation protocol can significantly increase students' beliefs that intelligence is malleable. The effectiveness of the intervention is consistent with international research involving adolescent participants and similar study designs. However, the current study built on the existing research by demonstrating that small yet powerful incremental theory interventions are effective with primary (elementary) students. The intervention proved to be effective at shifting students from an undecided to a growth mindset category. Overall, the predicted direction between students' goal orientation and mindset was consistent with national and international research, although these results for

performance approach and avoidance goals did not reach significance. Consistent with the broader research evidence, primary students' GPA scores did significantly correlate with mindset such that the more a student endorsed a malleable view of intelligence the better his or her GPA score.

In conclusion, this preliminary 'proof-of-concept' study has successfully demonstrated that students can be taught new ways to think about intelligence and that a more malleable mindset correlates with better learning outcomes. It is recommended that a larger-scale study be conducted to validate these preliminary findings and evaluate whether the intervention has long-term benefits on students' academic achievement.

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APPENDIX A

Your First Name	_____	**Your Last Name**	_____
Your Birth Date	_____	**Your Age**	_____
Male or Female	_____	**Family Culture**	_____

Instructions:

We are interested in your ideas. Please answer as honestly as you can. There are no right or wrong answers.

Using the scale below, please indicate the extent to which you agree or disagree with each of the following statements. Place a circle around the number that corresponds to your opinion for each statement.

1	2	3	4	5	6
Strongly Agree	**Agree**	**Mostly Agree**	**Mostly Disagree**	**Disagree**	**Strongly Disagree**

Try this practice example:

Eg.	I like ice cream	1	2	3	4	5	6

That was pretty easy wasn't it! If you think you've got the hang of it, try answering the rest of these items by placing one circle around a number. If there is a word you don't understand put your hand up and I will explain.

1	You have a certain amount of intelligence, and you can't really do much to change it.	1	2	3	4	5	6
2	Your intelligence is something about you that you can't change very much.	1	2	3	4	5	6
3	You can learn new things, but you can't really change your basic intelligence.	1	2	3	4	5	6
4	You can always substantially change how intelligent you are.	1	2	3	4	5	6
5	No matter how much intelligence you have, you can always change it quite a bit.	1	2	3	4	5	6
6	You can change even your basic intelligence level considerably.	1	2	3	4	5	6

FINISHED

Instructions:

APPENDIX B

Here are some questions about you as a student in this class. Using the scale below place a circle around the number that best describes what you think. There is no right or wrong answers.

If there is a word you don't understand put your hand up and I will explain.

1	2	3	4	5
NOT AT ALL TRUE		**SOMEWHAT TRUE**		**VERY TRUE**

1.	I'm certain I can master the skills taught in class this year.	1 2 3 4 5
2.	It's important to me that I learn a lot of new concepts this year.	1 2 3 4 5
3.	It's important to me that other students in my class think I am good at my class work.	1 2 3 4 5
4.	It's important to me that I don't look stupid in class.	1 2 3 4 5
5.	One of my goals in class is to learn as much as I can.	1 2 3 4 5
6.	I'm certain I can figure out how to do the most difficult class work.	1 2 3 4 5
7.	One of my goals is to show others that I'm good at my class work.	1 2 3 4 5
8.	One of my goals is to keep others from thinking I'm not smart in class.	1 2 3 4 5
9.	One of my goals is to master a lot of new skills this year.	1 2 3 4 5
10.	I can do almost all the work in class if I don't give up.	1 2 3 4 5
11.	One of my goals is to show others that class work is easy for me.	1 2 3 4 5
12.	It's important to me that my teacher doesn't think that I know less than others in class.	1 2 3 4 5
13.	Even if the work is hard, I can learn it.	1 2 3 4 5
14.	It's important to me that I thoroughly understand my class work.	1 2 3 4 5
15.	One of my goals is to look smart in comparison to the other students in my class.	1 2 3 4 5
16.	I can do even the hardest work in this class if I try.	1 2 3 4 5
17.	It's important to me that I improve my skills this year.	1 2 3 4 5
18.	One of my goals in class is to avoid looking like I have trouble doing the work.	1 2 3 4 5
19.	It's important to me that I look smart compared to others in my class.	1 2 3 4 5

FINISHED ☺

APPENDIX C

Office of the Deputy Vice-Chancellor
(Research)

Research Office
Research Hub, Building C5C East
Macquarie University
NSW 2109 Australia
T: +61 (2) 9850 4459
http://www.research.mq.edu.au/
ABN 90 952 801 237

MACQUARIE University
SYDNEY·AUSTRALIA

9 October 2015

Dr Anne McMaugh
School of Education
Faculty of Human Sciences
Macquarie University
NSW 2109

Dear Dr McMaugh

Reference No: 5201500758

Title: *Developing mindset skills: academic performance following a brief mindset intervention*

Thank you for submitting the above application for ethical and scientific review. Your application was considered by the Macquarie University Human Research Ethics Committee (HREC (Human Sciences & Humanities)) at its meeting on 25 September 2015 at which further information was requested to be reviewed by the Ethics Secretariat.

The requested information was received with correspondence on 30 September 2015.

I am pleased to advise that ethical and scientific approval has been granted for this project to be conducted at:

- Macquarie University

This research meets the requirements set out in the *National Statement on Ethical Conduct in Human Research* (2007 – Updated March 2014) (the *National Statement*).

This letter constitutes ethical and scientific approval only.

Standard Conditions of Approval:

1. Continuing compliance with the requirements of the *National Statement*, which is available at the following website:

http://www.nhmrc.gov.au/book/national-statement-ethical-conduct-human-research

2. This approval is valid for five (5) years, subject to the submission of annual reports. Please submit your reports on the anniversary of the approval for this protocol.

3. All adverse events, including events which might affect the continued ethical and scientific acceptability of the project, must be reported to the HREC within 72 hours.

4. Proposed changes to the protocol must be submitted to the Committee for approval before implementation.

It is the responsibility of the Chief investigator to retain a copy of all documentation related to this project and to forward a copy of this approval letter to all personnel listed on the project.

Should you have any queries regarding your project, please contact the Ethics Secretariat on 9850 4194 or by email ethics.secretariat@mq.edu.au

The HREC (Human Sciences and Humanities) Terms of Reference and Standard Operating Procedures are available from the Research Office website at:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics

The HREC (Human Sciences and Humanities) wishes you every success in your research.

Yours sincerely

Dr Karolyn White
Director, Research Ethics & Integrity,
Chair, Human Research Ethics Committee (Human Sciences and Humanities)

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007) and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

Education
Public Schools

Mr Kristopher Wrona
43 Leichhardt Street
RUSE NSW 2560

CORP15/27964
DOC15/763416
SERAP 2015339

Dear Mr Wrona

I refer to your application to conduct a research project in NSW government schools entitled *Developing mindset skills: supporting student's academic acheivement following a brief mindset intervention*. I am pleased to inform you that your application has been approved.

You may contact principals of the nominated schools to seek their participation. **You should include a copy of this letter with the documents you send to principals.**

This approval will remain valid until 12-Oct-2016.

The following researchers or research assistants have fulfilled the Working with Children screening requirements to interact with or observe children for the purposes of this research for the period indicated:

Researcher name	**WWCC**	**WWCC expires**
Kristopher Wrona	WWC0571486E	13-Jan-2020

I draw your attention to the following requirements for all researchers in NSW government schools:

- The privacy of participants is to be protected as per the NSW Privacy and Personal Information Protection Act 1998.
- School principals have the right to withdraw the school from the study at any time. The approval of the principal for the specific method of gathering information must also be sought.
- The privacy of the school and the students is to be protected.
  - The participation of teachers and students must be voluntary and must be at the school's convenience.
  - Any proposal to publish the outcomes of the study should be discussed with the research approvals officer before publication proceeds.
- All conditions attached to the approval must be complied with.

When your study is completed please email your report to: serap@det.nsw.edu.au You may also be asked to present on the findings of your research.

I wish you every success with your research.

Yours sincerely

Dr Robert Stevens
Manager, Research/Quality Assurance
12 October 2015

Policy, Planning and Reporting Directorate NSW Department of Education

APPENDIX D

SCHOOL OF EDUCATION
Faculty of Human Sciences

MACQUARIE University
SYDNEY·AUSTRALIA

PARTICIPANT INFORMATION AND CONSENT FORM

The Principal, Canley Heights Public School

Name of Project: **Developing mindset skills: academic performance following a brief mindset intervention.**

Dear Ms Hidson,

This study is focused on understanding why some school student's give-up when faced with an academic challenge, while others keep trying. Research has identified that learners can form 'fixed' mindset beliefs in which they believe that they are 'just no good at Math' or just 'Not smart enough to do well at school'. These students believe they have a 'fixed' intelligence' and nothing they can do will improve their ability. In contrast, other learners hold 'growth' mindset beliefs- they do not believe their intelligence is fixed, rather they believe that with effort and practice they can improve and learn more. These learners are motivated to try different strategies and tend to do well at school (Paunesku, et al., 2015; Blackwell, Trzesniewski & Dweck, 2007).

Researchers, predominantly in the USA, have provided evidence that simple educative interventions can change children's mindsets by making them more aware of how the brain 'works' e.g. the interventions teach student's that the *'brain is like a muscle'*- with practice and application of effort the brain continues to grow and learn (Blackwell, Trzesniewski & Dweck, 2007). We are interested in finding out whether or not these brief interventions can support the development of a growth mindset in an Australian cohort and if this makes a difference to student academic learning. I am writing to obtain permission to undertake this study with grade 6 students at Canley Heights Public School.

The study is being conducted by Mr Kris Wrona (Ph: 0421 847 532; kristopher.wrona@students.mq.edu.au) meet the requirements of Masters of Research under the supervision of Dr. Anne McMaugh (Ph: 9850 8663; anne.mcmaugh@mq.edu.au) of the School of Education, Macquarie University.

If you decide to allow the school to participate, all students in Years 5 and 6 will be invited to take part in the study. Students will be asked to answer a short questionnaire in class that shows their orientation towards a 'fixed' or 'growth' mindset as well as a short questionnaire about their learning goals. The questionnaires will take about 15 minutes to complete. Students will also participate in two brief mindset lessons; spaced two week apart during peer support time. A waitlist group will act as a control for this study and complete the questionnaires only (before a rotation of groups occur). The study lessons align with the mandatory Personal and Social Capability curriculum and explore the idea that our brains can change with effort. The lessons will be delivered by the researcher and will not impact on

teacher workload. We will also evaluate students semester one and two report cards to see if any positive changes occurred. The total time required for each lesson is anticipated at 50 minutes. In addition, should the school be willing, we would like to repeat the lessons for students not included in the research project upon its completion as we believe the content could be beneficial for their learning.

Any information or personal details gathered in the course of the study are confidential, except as required by law. No individual will be identified in any publication of the results. De-identified data may be made available to other researchers for future Human Research Ethics Committee-approved research projects, however no personal information will be made available to any other person. The findings of the study will be written in a report for your school.

Participation in this study is entirely voluntary: you are not obliged to allow the school to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence. Only those students whose parents explicitly consent to their child's participation will be invited to take part in the study.

Sincerely,

Dr Anne McMaugh and Mr Kris Wrona

I,_____Have read (or, where appropriate, have had read to me)and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to allow the school to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Name: (Block letters)

Signature: _____ Date:

Investigator's Name: Anne McMaugh

Investigator's Signature: _____ Date:

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

APPENDIX E

SCHOOL OF EDUCATION
Faculty of Human Sciences

MACQUARIE University
SYDNEY·AUSTRALIA

YEAR 5 INFORMATION AND CONSENT FORM

Dear Year 5 Student,

Name of Project: **Developing mindset skills: academic performance following a brief mindset intervention.**

I am writing to invite you to participate in a study I am doing in your School. The study is about how we learn. We learn new things every day and learning is sometimes fun but can be hard sometimes too. We would like to try to help students learn new ways of learning when the work is hard.

My name is Mr Kris Wrona and I am doing this study to help me complete a University project. My teacher at University, Dr. Anne McMaugh, is helping me with this project.

If you decide to participate, I will visit your classroom and teach two lessons over two weeks during term 4. For my project I will need to run the lessons in two groups. This means that I will teach some of you the lessons during weeks 3 and 4, and the remaining students during weeks 5 and 6. The lessons are the same and you will all participate, so it doesn't matter which group you are in. During the lessons you will complete two small questionnaires about your learning goals and beliefs as a learner. You will do some simple activities in the lessons that will help me to understand your thoughts about learning when it is hard. Each lesson should take up about 50 minutes of your time. This is not a test and your personal answers will not be shown to anyone else. There is a chance you will learn some new things that might help you when you are learning in the future. In addition, I would like to repeat the lessons for students not included in the research project upon its completion as I believe the content could be beneficial for your learning.

All the information you give me from the activities are confidential. This means that your name will not be revealed when I write my project and your personal results will not be shown to anyone else. I will write a report about the study for your school and for your parents, but your personal details will be private and not revealed in the report.

Participating in the research study is voluntary- that means you do not have to participate if you don't want to. If you would like to participate please sign the form below and also ask your parents to give you permission to do the study at school. You can stop participating in the study at any time for any reason and without any consequences.

Thank you for reading my letter,

Mr Wrona

I,_____Have read *(or, where appropriate, have had read to me)* and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Name: _____

(Block letters) _____

Signature _____Date:_____

Investigator's Name: Anne McMaugh Date:

Investigator's Signature: 12.10.15

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

SCHOOL OF EDUCATION
Faculty of Human Sciences

MACQUARIE University
SYDNEY·AUSTRALIA

YEAR 6 INFORMATION AND CONSENT FORM

Dear Year 5 Student,

Name of Project: **Developing mindset skills: academic performance following a brief mindset intervention.**

I am writing to invite you to participate in a study I am doing in your School. The study is about how we learn. We learn new things every day and learning is sometimes fun but can be hard sometimes too. We would like to try to help students learn new ways of learning when the work is hard.

My name is Mr Kris Wrona and I am doing this study to help me complete a University project. My teacher at University, Dr. Anne McMaugh, is helping me with this project.

If you decide to participate, I will visit your classroom and teach two lessons over two weeks during term 4. For my project I will need to run the lessons in two groups. This means that I will teach some of you the lessons during weeks 3 and 4, and the remaining students during weeks 5 and 6. The lessons are the same and you will all participate, so it doesn't matter which group you are in. During the lessons you will complete two small questionnaires about your learning goals and beliefs as a learner. You will do some simple activities in the lessons that will help me to understand your thoughts about learning when it is hard. Each lesson should take up about 50 minutes of your time. This is not a test and your personal answers will not be shown to anyone else. There is a chance you will learn some new things that might help you when you are learning in the future. In addition, I would like to repeat the lessons for students not included in the research project upon its completion as I believe the content could be beneficial for your learning.

All the information you give me from the activities are confidential. This means that your name will not be revealed when I write my project and your personal results will not be shown to anyone else. I will write a report about the study for your school and for your parents, but your personal details will be private and not revealed in the report.

Participating in the research study is voluntary- that means you do not have to participate if you don't want to. If you would like to participate please sign the form below and also ask your parents to give you permission to do the study at school. You can stop participating in the study at any time for any reason and without any consequences.

Thank you for reading my letter,

Mr Wrona

I,_____Have read *(or, where appropriate, have had read to me)* and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Name: _____

(Block letters) _____

Signature _____ Date:_____

Investigator's Name: Anne McMaugh Date:

Investigator's Signature: 12.10.15

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

APPENDIX F

SCHOOL OF EDUCATION
Faculty of Human Sciences

MACQUARIE University
SYDNEY·AUSTRALIA

PARENT INFORMATION AND CONSENT FORM

Dear Parent,

Name of Project: **Developing mindset skills: academic performance following a brief mindset intervention.**

I am writing to invite your Year 5 child to participate in a study I am conducting at Canley Heights Public School. This study is trying to understand why some school student's give-up when class work is difficult, while others keep trying. We believe understanding this is important for the success of all students' learning, including your own. Research has shown that some students can form beliefs that they are 'Not smart enough to do well at school'. Whereas, other students believe that with effort and practice they can improve and learn more. These learners tend to do well at school.

We are interested in trying a simple intervention in which students learn about how their brain works as well as learn some useful strategies that may improve their learning outcomes. We hope to find out if this brief intervention can support student academic learning.

The study is being conducted by Mr Kris Wrona (Ph: 0421 847 532; kristopher.wrona@students.mq.edu.au) to meet the requirements of Masters of Research under the supervision of Dr. Anne McMaugh (Ph: 9850 8663; anne.mcmaugh@mq.edu.au) of the School of Education, Macquarie University.

If you decide to allow your child to participate, they will complete two short questionnaires in class about their learning goals and learning style. The questionnaires will take about 15 minutes to complete. Children will also participate in two brief lessons, spaced two weeks apart during peer support time. The lessons will be taught by Mr Wrona in two groups during term 4. Delivering the lessons in groups allow for a higher standard of research and minimises potential disruption to school routines. The first group will participate in the lessons during weeks 3 and 4. The second group with participate in the lesson during week 5 and 6. The lessons will teach children that our brain has a lot of learning potential, and our learning potential can improve with practice and effort. Your child will also receive information (learning strategies) that may assist with their classroom learning. With your permission, I would also like to review your child's school report for Terms 2 and 4 to see if these lessons have improved their results. The time allocated for this study is 50 minutes per lesson and it will not be counted towards your child's class grades or report. In addition, we would like to repeat the lessons for students not included in the research project upon its completion as we believe the content could be beneficial for their learning.

All information or personal details gathered in the course of the study are confidential, except as required by law. No individual will be identified in any publication of the results. De- identified data may be made available to other researchers for future Human Research Ethics Committee-approved research projects; however no personal information will be made available to the school or any other person. The findings of the study will be written in a report for your school and you may also request a copy.

Participation in this study is entirely voluntary: you are not obliged to allow your child to participate and if you decide to consent to participation, you are free to withdraw this consent at any time without having to give a reason and without consequence. Only those students whose parents explicitly consent to their child's participation will be invited to take part in the study. I have also included information and a consent form for your child.

I,_____Have read *(or, where appropriate, have had read to me)* and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Name: _____

(Block letters) _____

Signature _____Date:_____

Investigator's Name: Anne McMaugh Date:

Investigator's Signature: 12.10.15

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

MACQUARIE University
SYDNEY·AUSTRALIA

SCHOOL OF EDUCATION
Faculty of Human Sciences

PARENT INFORMATION AND CONSENT FORM

Dear Parent,

Name of Project: **Developing mindset skills: academic performance following a brief mindset intervention.**

I am writing to invite your Year 6 child to participate in a study I am conducting at Canley Heights Public School. This study is trying to understand why some school student's give-up when class work is difficult, while others keep trying. We believe understanding this is important for the success of all students' learning, including your own. Research has shown that some students can form beliefs that they are 'Not smart enough to do well at school'. Whereas, other students believe that with effort and practice they can improve and learn more. These learners tend to do well at school.

We are interested in trying a simple intervention in which students learn about how their brain works as well as learn some useful strategies that may improve their learning outcomes. We hope to find out if this brief intervention can support student academic learning.

The study is being conducted by Mr Kris Wrona (Ph: 0421 847 532; kristopher.wrona@students.mq.edu.au) to meet the requirements of Masters of Research under the supervision of Dr. Anne McMaugh (Ph: 9850 8663; anne.mcmaugh@mq.edu.au) of the School of Education, Macquarie University.

If you decide to allow your child to participate, they will complete two short questionnaires in class about their learning goals and learning style. The questionnaires will take about 15 minutes to complete. Children will also participate in two brief lessons, spaced two weeks apart during peer support time. The lessons will be taught by Mr Wrona in two groups during term 4. Delivering the lessons in groups allow for a higher standard of research and minimises potential disruption to school routines. The first group will participate in the lessons during weeks 3 and 4. The second group with participate in the lesson during week 5 and 6. The lessons will teach children that our brain has a lot of learning potential, and our learning potential can improve with practice and effort. Your child will also receive information (learning strategies) that may assist with their classroom learning. With your permission, I would also like to review your child's school report for Terms 2 and 4 to see if these lessons have improved their results.

The time allocated for this study is 50 minutes per lesson and it will not be counted towards your child's class grades or report. In addition, we would like to repeat the lessons for students not included in the research project upon its completion as we believe the content could be beneficial for their learning.

All information or personal details gathered in the course of the study are confidential, except as required by law. No individual will be identified in any publication of the results. De-identified data may be made available to other researchers for future Human Research Ethics Committee-approved research projects; however no personal information will be made available to the school or any other person. The findings of the study will be written in a report for your school and you may also request a copy.

Participation in this study is entirely voluntary: you are not obliged to allow your child to participate and if you decide to consent to participation, you are free to withdraw this consent at any time without having to give a reason and without consequence. Only those students whose parents explicitly consent to their child's participation will be invited to take part in the study. I have also included information and a consent form for your child.

I,_____Have read *(or, where appropriate, have had read to me)* and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Name: _____

(Block letters) _____

Signature _____ Date:_____

Investigator's Name: Anne McMaugh Date:

Investigator's Signature: 12.10.15

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics and Integrity (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

APPENDIX G

Topic Focus: Growth Mindset

Target Group: Year 6 students

Duration: Delivery over 2 x 40-50 minute sessions

Objectives:

By the end of the two sessions, students will understand:

- Intelligence is not static but can be developed
- The brain is malleable
- Doing challenging work is the best way to make the brain stronger and smarter

Acknowledgement:

These lessons are based on a lesson plan originally developed by Khan Academy and PERTS, Stanford University's applied research center on academic motivation: www.khanacademy.org/coach-res/reference-for-coaches/how-to/a/growth-mindset-lesson-plan

They have been adjusted and modified for an Australian context by Kris Wrona and Jennifer Jones. All materials taken from these original resources are used with permission.

Background Information for Teachers

The background information provided by Khan Academy and PERTS for the original "Growth Mindset Lesson Plan" should be re-stated here:

> Cultivating a growth mindset in students can (unfortunately) be quite tricky. Researchers and educators have spent years thinking about this, and we are still learning! From our experiences thus far, we have learned that:
>
> - Simply telling students to have a growth mindset can backfire. Students have a negative reaction to being told how to think. Instead a more scientific and practical explanation about how intelligence works - that the brain can get stronger and smarter with new learning - has been demonstrated to be effective.
> - In the same vein, reiterating the message "just try harder" can also be problematic. The reason is that most students have heard "just try harder", but a growth mindset isn't just about trying harder. Students need to understand why they should put in more effort and how to deploy that effort.

SOURCE: www.khanacademy.org/coach-res/reference-for-coaches/how-to/a/growth-mindset-lesson-plan

Activity Sequence:

This sequence of lessons is to be delivered over two sessions. These may be on the same or subsequent days or with up to a week intervening.

Rationale for Teaching/Learning Sequence:

The activities in this lesson sequence are designed to move students through a process spanning initial concrete/ visual engagement with the topic, through to exploratory talk and then on to more abstract thinking and personal applications. The activities and resources have been selected to maximise opportunity for initial visual input, multi-modal engagement with the content and reinforcement of key vocabulary.

Parallel to this, the activities are designed to engage students in language use which moves from "more spoken-like" to "more written-like". The literacy products which feature in

these lessons are simple and should be supported by teacher modelling and joint construction, as required.

Curriculum Links:

These lessons are mapped to ***Personal & Social Capability Learning Continuum*** on the ***National Curriculum:***

Personal & Social Capability		**Level 3** *Typically by the end of Year 4, students:*	**Level 4** ***Typically by the end of Year 6, students:***	**Level 5** *Typically by the end of Year 8, students:*
Self- awareness	***Recognise personal qualities & achievements***	describe personal strengths and challenges and identify skills they wish to develop	**describe the influence that personal qualities and strengths have on their learning outcomes**	make a realistic assessment of their abilities and achievements, and prioritise areas for improvement
	Understand themselves as learners	identify and describe factors and strategies that assist their learning	**identify preferred learning styles and work habits**	identify and choose a range of learning strategies appropriate to specific tasks and describe work practices that assist their learning
	Develop reflective practice	reflect on personal strengths and achievements, based on self-assessment strategies and teacher feedback	**monitor their progress, seeking and responding to feedback from teachers to assist them in consolidating strengths, addressing weaknesses and fulfilling their potential**	predict the outcomes of personal and academic challenges by drawing on previous problem-solving and decision-making strategies and feedback from peers and teachers
Self-management	***Develop self-discipline and set goals***	explain the value of self-discipline and goal-setting in helping them to learn	**analyse factors that influence ability to self-regulate; devise and apply strategies to monitor own behaviour and set realistic learning goals**	select, use and analyse strategies that assist in regulating behaviour and achieving personal and learning goals
	Become confident, resilient and adaptable	persist with tasks when faced with challenges and adapt their approach where first attempts are not successful	**devise strategies and formulate plans to assist in the completion of challenging tasks and the maintenance of personal safety**	assess, adapt and modify personal and safety strategies and plans, and revisit tasks with renewed confidence

These lessons also support teaching/learning outcomes in the ***NSW Personal Development, Health and Physical Education (PDHPE) Syllabus:***

Stage 3 PDHPE (NSW Board of Studies)

GDS3.9 Explains and demonstrates strategies for dealing with life changes

Relevant indicators:

- suggests ways of developing new skills and competencies, eg practice, peer tutoring, goal setting, seeking support
- describes aspects of social and emotional growth and development

Values and Attitudes

V1: refers to a sense of their own worth and dignity

Relevant indicators:

- accepts themselves as they grow and change
- appreciates that their physical, social, emotional and intellectual development is unique
- expresses a realistic perception of their personal capabilities

V6: commits to realising their full potential

Relevant indicators:

- acknowledges effort in achieving results

Word Bank:

malleable, plastic, plasticity, neuroplasticity, change, stimulating, fixed, growth, mindset, intelligence, beliefs, behaviours,

Session 1: 40-50 minutes

Required Materials:

- **play dough or plasticine (enough for each student to have a small lump to start with**)
  NB: This should be divided into portions prior to the lesson and then kept refrigerated until use so that the portions are harder than they would be at room temperature. The idea is that as the students work the plasticine/ play dough, it will become more malleable.
- **Projector/ screen**
- **Laptop/ Computer, internet connection, access to YouTube**
- **Softcopy: PDF of provided images of Neural connections, Figures 1-3**
- **Student Worksheets: "Postcard to Self" or postcard-size cardboard sheets**

YouTube

❶ Watch "You can grow your intelligence" by Wave TV (5 minutes); Distribute article "You can grow your intelligence" (A1), by Lisa Blackwell (15 minutes)

Q: The title of this article and second paragraph suggest that our '*brain is like a muscle'*, what does this mean. (Refer to the saying *'use it or lose it'* from the article to support your answer?)
Q: Provide two examples from the section titled '*How do we know the brain can grow stronger?'* that support this argument.
Q: Page three discusses the key to growing the brain. What is it? How do the images of the development of a nerve cell support this?
Q: What is the real truth about "smart and dumb?" as discussed on the last page.

❷Hands on Activity: Manipulating cold play dough (5 minutes)

Have students make their small lump of play dough into 2-3 different shapes e.g. a ball, a long worm, a flat "2-D"shape

Q: What does it mean that something is "malleable" or "plastic"?
Q: What did you notice happen as you worked the play dough? (Was it easier to mould?)

Today we are going to be looking at the brain and intelligence.
Q: (Tell the person next to you) In your view, would you say that intelligence is more like a rock than playdough? To what extent do you think it can be changed?

OR

❷Hands on Activity: Make a neuron (A2) (5 minutes)

Have students make a neuron from one of the two options provided. How does this activity relate to the idea of practice and growing your brain?

YouTube

❸Watch "Neuroplasticity" by Sentis (2:03) (8 minutes)

Q: What is neuroplasticity? (write the word on the board) (Break it down into its component parts to emphasise "neuro-" and "-plasticity"
Q: How does neuroplasticity work?
Q: How can you "re-wire" your brain?
Q: What do you think the saying "Neurons that fire together, wire together" means.

❹ Personal Discussion: (5 mins)

Discuss a time when you overcame a struggle in learning and learned to solve a problem.
TEACHER DISCLOSURE: As a teacher, share a personal story about a time you had to work hard to get better at something and relate it to the YouTube clip on Neuroplasticity. As you relate this personal anecdote, highlight:

1. Hard work/ persistence
2. Strategies (problem-solving)
3. Help from others

❺ Postcard to Self (writing/ creating task) (A3) (10-20 minutes)

NB: This composition could be presented on a piece of cardboard which is postcard size. Alternatively, a simple template (standard A4 worksheet) is provided. To enhance this process, as the teacher, create your own postcard to provide an example/ model of what might be done and allow students to refer to it.

Part 1: Draw a picture/ cartoon (or series of pictures), which together represent a time you found learning tough…but you overcame the challenge: How did you overcome it? How did you feel throughout the experience? What did you learn?
Part 2: Send yourself a postcard. What advice can you give your future self about overcoming any future learning challenges?

The idea is that the teacher collects the finished products and shares them back with students at a future date, when students are learning a new concept or exam stress etc.

Session 2: 40-50 minutes

Required Materials:

- **Projector/ screen**
- **Laptop/ Computer**
- **Softcopy: Neuroplasticity Concept Map (to be projected on screen)**
- **Photocopied strips of Images: Figures 1-3** (pre-cut and ready for distribution), 1 strip per student
- **Student Worksheets: Concept Map, Fixed/ Growth template**
- **Glue, scissors**

❶ Watch "You can learn anything" by Khan Academy (5 minutes)

Teacher facilitated discussion on key points from media clip to flow into concept map (below)

❷ Concept Map: Neuroplasticity (A4) (re-capping and re-engaging with the topic) (5 minutes)

This is a teacher-facilitated process. Students can take their own notes throughout on the smaller concept map provided on the worksheet.

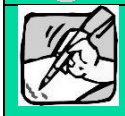
❸ Re-engaging with Visual Images: Cut & Paste Task (A5) (5 minutes)

Using the provided student worksheet, have students select one of the images of neural connections to cut out and paste in the provided box on the worksheet (these images were referred to in the previous session).

Q: Which of the three diagrams has the most impact on you? Why? What drew you to it?

❹ Responding to challenges (A6) (10 minutes)

Using the provided worksheet, have students complete the activities that differentiate a fixed and growth mindset- based on the fictional vignettes.



❺ Growth vs Fixed Mindset Poster-making (A7) (20+ minutes)

THIS TASK IS TAKEN DIRECTLY FROM THE KHAN ACADEMY/ PERTS LESSON PLAN

Using your students' input, make a two-column poster on the *beliefs* and *behaviours* of a ***growth*** mindset and how it compares to a ***fixed*** mindset. Urge students to map out how beliefs influence behaviours which ultimately lead to results.

If they need scenarios to help the brainstorm, use the examples below or create your own! What are the behaviours/thoughts of people who believe intelligence can be developed when:

- …they fail a test?
- …they put a lot of effort into practising for a soccer game but still lose?
- …they don't understand a maths problem?
- …they are not putting any effort into class but are still passing?

	Use this poster as a reference throughout the year to help students recognise when they have a fixed mindset and to give them ideas on methods to shift them towards a growth mindset. A high-end professional mindset poster has been included as an example (A8).

Blackwell et al., (2007) Articale- transcript to video You can Grow Your Intelligence (WaveTV, 2013).

You Can Grow Your Intelligence

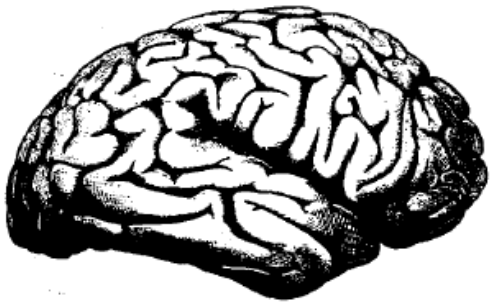
New Research Shows the Brain Can Be Developed Like a Muscle

Many people think of the brain as a mystery. They don't know much about intelligence and how it works. When they do think about what intelligence is, many people believe that a person is born either smart, average, or dumb–and stays that way for life.

But new research shows that the brain is more like a muscle--it changes and gets stronger when you use it. And scientists have been able to show just how the brain grows and gets stronger when you learn.

Everyone knows that when you lift weights, your muscles get bigger and you get stronger. A person who can't lift 20 pounds when they start exercising can get strong enough to lift 100 pounds after working out for a long time. That's because the muscles become larger and stronger with exercise. And when you stop exercising, the muscles shrink and you get weaker. That's why people say "Use it or lose it!

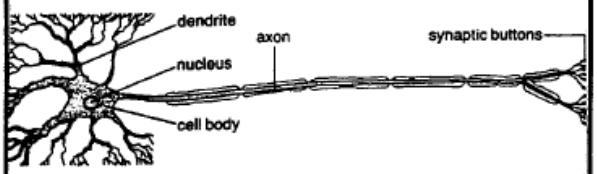
But most people don't know that when they practice and learn new things, parts of their brain change and get larger a lot like muscles do when they exercise.



Inside the cortex of the brain are billions of tiny nerve cells, called neurons. The nerve cells have branches connecting them to other cells in a complicated network. Communication between these brain cells is what allows us to think and solve problems.

A Section of the Cerebrum

When you learn new things, these tiny connections in the brain actually multiply and get stronger. The more that you challenge your mind to learn, the more your brain cells grow. Then, things that you once found very hard or even impossible to do--like speaking a foreign language or doing algebra–seem to become easy. The result is a stronger, smarter brain.



A Typical Nerve cell

How Do We Know the Brain Can Grow Stronger?

Scientists started thinking that the human brain could develop and change when they studied animals' brains. They found out that animals who lived in a challenging environment, with other animals and toys to play with, were different from animals who lived alone in bare cages.

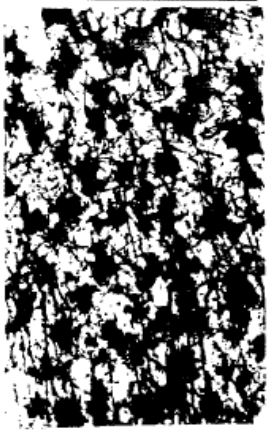
While the animals who lived alone just ate and slept all the time, the ones who lived with different toys and other animals were always active. They spent a lot of time figuring out how to use the toys and how get along with the other animals.

These animals had more connections between the nerve cells in their brains. The connections were bigger and stronger, too. In fact, their whole brains were about 10% heavier than the brains of the animals who lived alone without toys.

The animals who were exercising their brains by playing with toys and each other were also "smarter"--they were better at solving problems and learning new things.

Even old animals got smarter and developed more connections in their brains when they got the chance to play with new toys and other animals. When scientists put very old animals in the cages with younger animals and new toys to explore, their brains grew by about 10%!

Nerves in brain of animal living in bare cage.



Brain of animal living with other animals and toys.

Children's Brain Growth

Another thing that got scientists thinking about the brain growing and changing was babies. Everyone knows that babies are born without being able to talk or understand language. But somehow, almost all babies learn to speak their parents' language in the first few years of life. How do they do this?

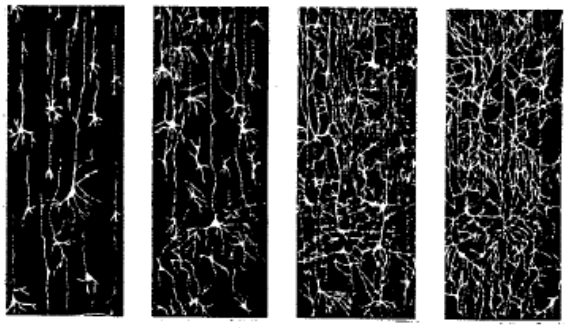
The Key to Growing the Brain: Practice!

From the first day they are born, babies are hearing people around them talk–all day, every day, to the baby and to each other. They have to try to make sense of these strange sounds and figure out what they mean. In a way, babies are exercising their brains by listening hard.

Later, when they need to tell their parents what they want, they start practicing talking themselves. At first, they just make goo-goo sounds. Then, words start coming. And by the time they are three years old, most can say whole sentences almost perfectly.

Once children learn a language, they don't forget it. The child's brain has changed–it has actually gotten smarter.

This can happen because learning causes permanent changes in the brain. The babies' brain cells get larger and grow new connections between them. These new, stronger connections make the child's brain stronger and smarter, just like a weightlifter's big muscles make them strong.



Newborn 3months 15 months 2 years

Development of nerve cells in the brain from birth to 2 years old. The nerve cells grow both in size and in number of connections between them.

The Real Truth About "Smart" and "Dumb"

No one thinks babies are stupid because they can't talk. They just haven't learned how to yet. But some people will call a person dumb if they can't solve math problems, or spell a word right, or read fast--even though all these things are learned with practice.

At first, no one can read or solve equations. But with practice, they can learn to do it. And the more a person learns, the easier it gets to learn new things–because their brain "muscles" have gotten stronger!

The students everyone thinks is the "smartest" may not have been born any different from anyone else. But before they started school, they may have started to practice reading. They had already started to build up their "reading muscles." Then, in the classroom, everyone said, "That's the smartest student in the class."

They don't realize that any of the other students could learn to do as well if they exercised and practiced reading as much. Remember, all of those other students learned to speak at least one whole language already–something that grownups find very hard to do. They just need to build up their "reading muscles" too.

What Can You Do to Get Smarter?

Just like a weightlifter or a basketball player, to be a brain athlete you have to exercise and practice. By practicing you make your brain stronger. You also learn skills that let you use your brain in a smarter way--just like a basketball player learns new moves.

But many people miss out on the chance to grow a stronger brain because they think they can't do it, or that it's too hard. It does take work, just like becoming stronger physically or becoming a better ball player does. Sometimes it even hurts! But when you feel yourself get better and stronger, all the work is worth it!

E-mail questions or comments to:
Growyourbrain@aol.com

Mindset: Postcard Activity (Session 1)

Draw a picture/ cartoon (or series of pictures), which together represent a time you found learning tough…but you overcame the challenge:

- How did you overcome it?
- How did you feel throughout the experience?
- What did you learn?

POSTCARD TO SELF:

Figure 1: Synapse Density over Time

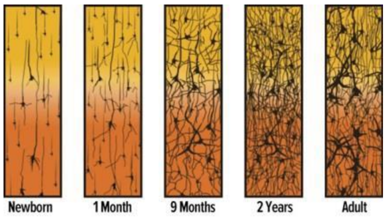


Figure 2: Neuron Connections in a Child: At birth vs Age 6

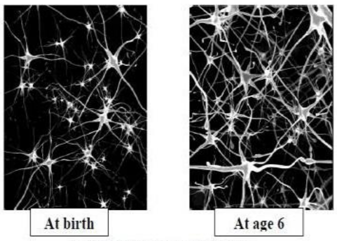
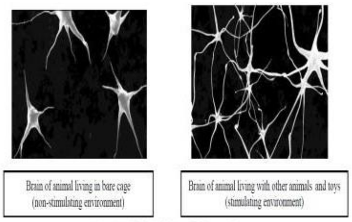


Figure 3: Nerve Comparison between Animals (caged vs stimulating environment)



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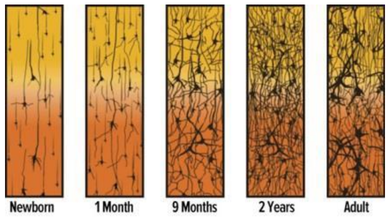

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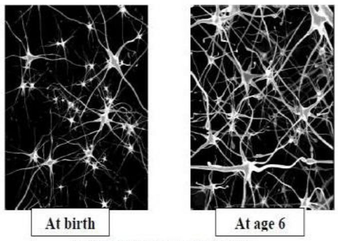

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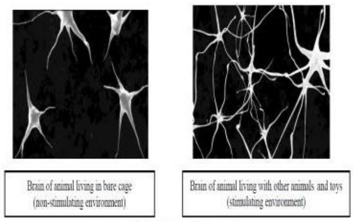

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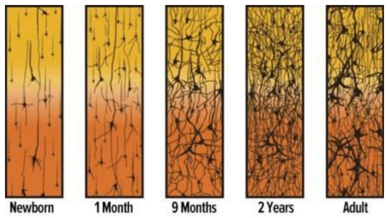

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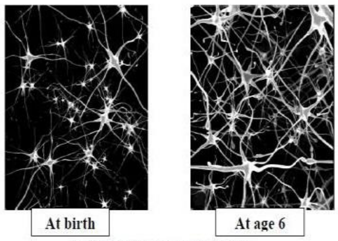

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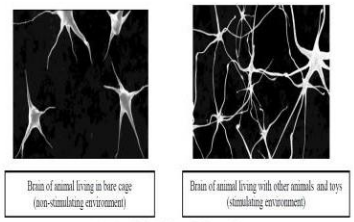

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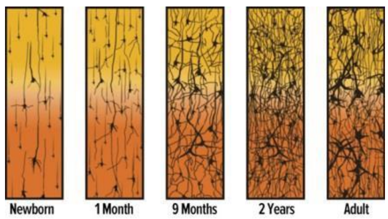

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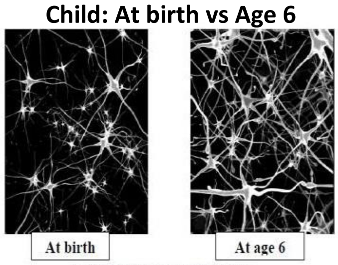

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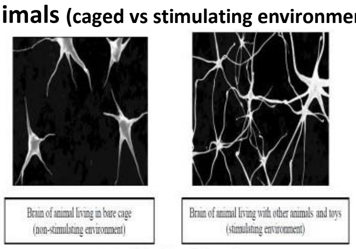

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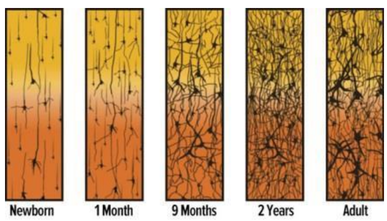

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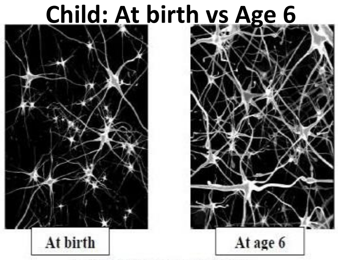

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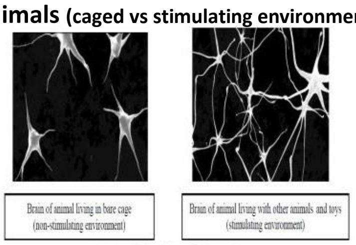


Growth Mindset: Concept Map (Session 2)

Which of the three diagrams has the most impact on you? Cut it out and stick it below.

	Why did you choose this picture? What is it about the image that stands out to you?

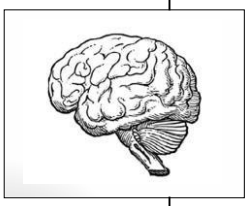
1. Definition

What is neuroplasticity?

2. Characteristics

What are its core qualities? How would you describe it?

Related words, ideas & metaphors:



neuroplasticity

3. Examples *What are some examples of*

I'm just not a natural at this subject…what's the point?

This is so easy, I can get by without any effort in this class.

I can get better. I just have to keep learning.

This worksheet is easy. What else can I learn? I might be able to get by without trying, but I could get an A if I just studied 10 minutes every day.

Growth Mindset: Responding to Challenges (Session 2)

Joe and Jack are in the same year 6 class. Notice how they respond differently to a tough math problem.

"Joe Stay-the-Same" has a fixed mindset. He tends to…

Tells himself he's no good at the task; feels helpless. (Oh, no. I hate math word problems. I'm just no good at them.)

Prefers repeating successes to taking on a new challenge. (Why don't we just do addition? It's much easier.)

See setbacks as indications that he's a failure. (I'm such an idiot; I can't even do the first problem.)

Worries about whether he looks smart. (Everybody's getting it but me. They'll think I'm stupid if I ask questions.)

"Jack Change" has a growth mindset. He tends to…

Approaches challenges with interest rather than doubt. (This is a tricky word problem. I've got to think it through. No-one is ever perfect.)

Focuses on the problem rather than on himself. (Let me see… I can try what my teacher showed me…)

Sees setbacks as indications that he needs to apply more effort. (No, that didn't work. Better switch gears… What else can I do?)

Works collaboratively, rather than competitively, with others; see helping others as a way of developing his own knowledge. (I wonder if anyone needs help. Explaining it will help me understand it better.)

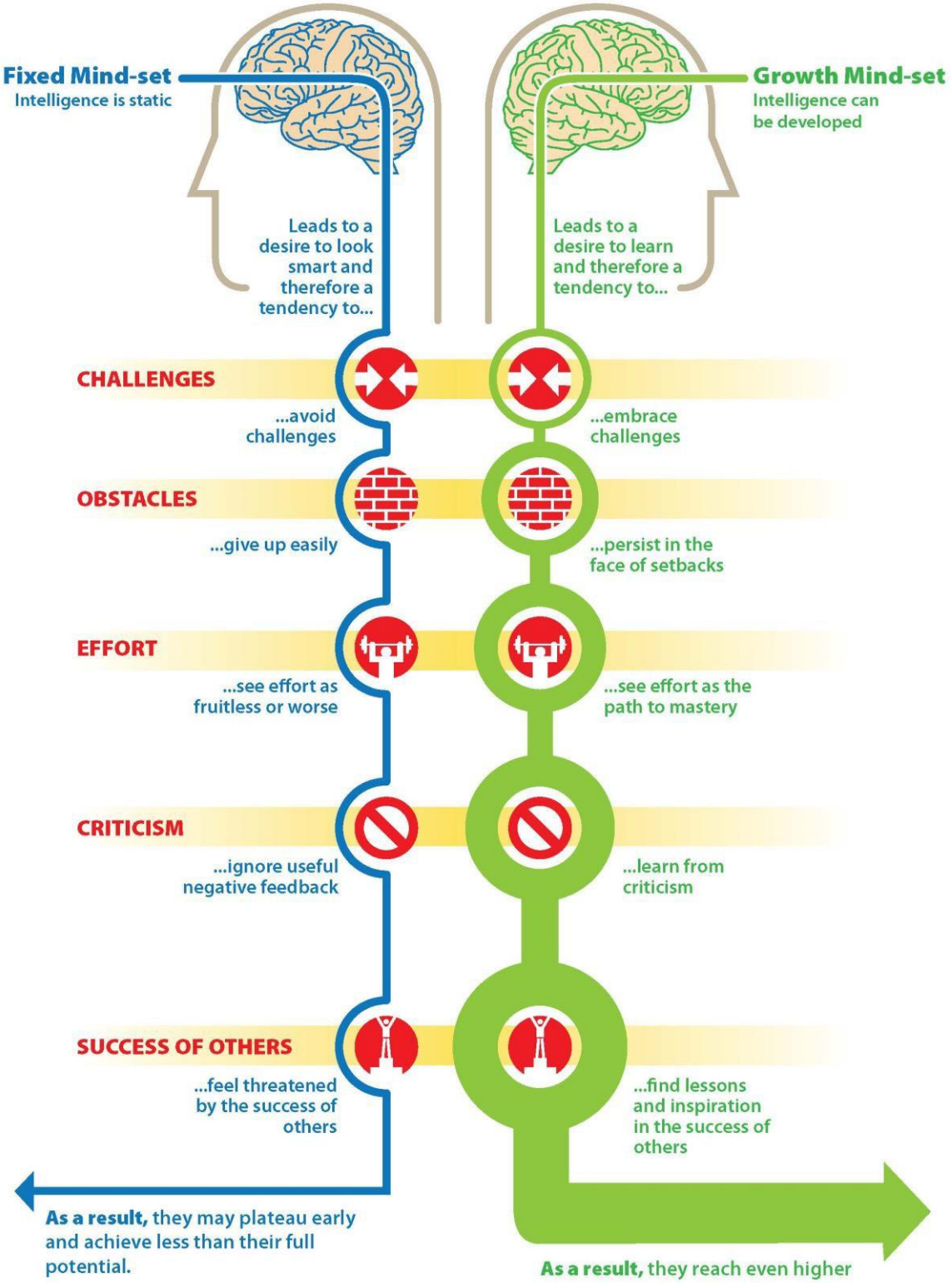
Directions: Write in each box what Joe and Jack might say or do in response to the given situations.

The first one has been completed as an example.

Situation	Fixed Mindset Response (Joe)	Growth Mindset Response (Jack)
Receives a low grade on an assignment.	"I feel so stupid. I might as well give up."	"I need to find out where I went wrong as I have time to improve before the next assignment is due. I can do it"
Has to give a speech in English class but fears public speaking.		

Sees lots of red written over his homework sheet (that his teacher has marked.)		
Has a final year exam coming up soon.		

Two Mindsets



Graphics by Nigel Holmes based on research by Carol Dweck http://dww.ed.gov DOINGWHATWORKS