Enabling teachers to promote incremental theories of intelligence in young children: an intervention and an instrument

Nicholas James Garnett

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Abstract

The primary focus of this thesis was to translate the rich 'implicit theories of intelligence' framework into an accessible intervention to allow teachers to promote growth mindsets in their pupils. A growth mindset is an implicit belief that one can grow one's intelligence through learning and effort. Research suggests that those with a growth mindset will seek out challenges, are focussed on their learning rather than their results, and have a more positive response to failure. Previous research has linked these behaviours with increased educational attainment, especially for pupils at risk of not achieving their educational potential.

This project was completed in partnership with the Stoke Reads programme from the City of Stoke-on-Trent Council. The goal was to provide young learners in the City with the best possible literacy learning environment. The toolkit developed in this thesis is called the 'Stoke Reads Mindset Kit' and was developed utilising a co-creation approach, this meant working in parallel with a group of experts in early years literacy education to develop the intervention.

To explore whether the intervention was successful in its aims, an instrument to measure mindsets in young children was developed – the Mindset Measure for Young Children (MMYC). The first version of the instrument was trialled with adults to ensure the instrument had convergent validity with existing constructs (N=89). Following revisions, a trial was carried out with Reception pupils - the same age as those participating in the intervention. This was to assess if the instrument was sufficiently accessible for young children (N=51) and to evaluate

test re-test reliability. Finally, to investigate the structure of the implicit theories framework the instrument was then trialled with a sample of adult participants, alongside existing instruments for every component of the implicit theories framework, e.g. response to failure, learning goals etc. (N = 125). The results suggested that the MMYC had convergent validity with existing instruments. However, a different structure to the framework as described in the literature was found, for example, a mastery response to failure did not clearly relate to a growth mindset.

Finally, the 'Stoke Reads Mindset Kit' was evaluated in a quasi-experimental design in schools across the City for one academic year ($N_{pupils} = 443$, $K_{schools} = 9$). The findings suggest that key behaviours (e.g. positive response to failure) which the intervention was designed to promote were successfully increased, but pupil's mindsets did not always change. In line with previous research, it was found that pupils at risk of academic underachievement benefitted the most from a growth mindset. However, there was no evidence to support the hypothesis that a growth mindset would help raise pupil aspirations. Finally, teacher feedback about the intervention was positive and data suggested that they had a more positive view of their pupils' potential following their engagement with the Stoke Reads Mindset Kit. The key contributions of this thesis are: the development of a novel psychometric instrument to measure mindsets in young children; that it is possible to translate the rich theoretical framework into a 'light-touch' intervention; and that the structure of the implicit theories framework may not be as previously described.

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situations, is truly inspiring. Finally, to the pupils and their parents, this research is dedicated to you.

1. Introduction

The focus of this thesis is the development of an intervention, as such this introductory chapter aims to present the reader with a broad overview of the theoretical framework in which the research is situated. This chapter begins with a description of the funders and partners of the project. This is included to give the reader an appreciation of the context surrounding the research undertaken in this thesis, which will aid understanding of the decisions taken and outlined in subsequent chapters. Following this, a general introduction to the implicit theories of intelligence framework is presented, the research questions addressed in the thesis are outlined and the chapter concludes with a short overview of each subsequent chapter.

1.1. The context of the current research

It is important to provide background information about how this thesis was funded and the context in which the research took place. Presented below are the historic challenges of literacy education in the City of Stoke-on-Trent, the aims of the programme which funded this project, and some of the constraints in developing it.

The City of Stoke-on-Trent has historically had very low rates of literacy. In 2002, research undertaken by the City of Stoke-on-Trent Council suggested that 69.4% of pre-school children were significantly behind in their use of language (Titley, Shered, Difusco, Baddley, & Convey, 2005). To combat this, the City Council created a multi-agency group called Stoke Speaks Out, it aimed to engage and train anyone who linked with children in any way, including parents, carers, and practitioners to enhance early speech. The programme had a positive impact on children as the data from 2017 suggests that 54% of children aged 2-5 had language and communication skills at developmentally appropriate levels, and only 13% of children were identified as having severely delayed speech and language (City of Stoke-on-Trent, 2017). In 2014, Ofsted conducted a study exploring how reading was taught across the City. They found that reading was "not taught well enough in 7 of the 12 schools [they studied]" (p.1), and they summarised that Key Stage 1 teaching was the poorest (Ofsted, 2014). To combat the issue, Stoke Speaks Out was asked to replicate the success of the programme but with a focus on promoting reading in Early Years. This led to the development of a daughter programme called Stoke Reads. Stoke Reads aimed to engage parents and practitioners in reading and create a network of peer-support, best practice sharing, and make expert practitioners available for teachers to work with. The programme had several goals: increase reading attainment in Year 2 pupils in their end of year Standardised Assessment Tests (SATs), create a 'buzz' around reading across the City, and promote a wider City objective of raising aspiration.

An initial group of 14 primary schools, representing a spectrum of achievement and socioeconomic status of the population from across the City were selected to form the core Stoke Reads group. This also included librarians, speech and language therapists, and academics. The author was also member of this executive committee. Stoke Reads aimed to promote a culture of reading throughout the City of Stoke-on-Trent, linking all organisations who are involved in young children's reading. The target age range of the project was birth through to the end of Key Stage 1 (0-7 years of age) as the programme fell under the City's 'pre-school readiness strategy'. To help evaluate the work of Stoke Reads, each school collected phonics and reading data from pupils at the end of Reception and the beginning of Year 1. The author's role within the programme was to analyse the phonics and reading data and design an intervention to promote the most positive environments for learning to read to take place. It was decided that growth mindsets (implicit theories of intelligence) have many potential benefits for pupils learning to read within the City of Stoke-on-Trent. The following section will outline what these are.

Finally, it is important to situate the Stoke Reads programme and this research in a slightly wider context beyond those directly involved in it. The programme was funded from the City of Stoke-on-Trent Council and initially commissioned for three years (2015-2018). As local authority funding was uncertain (for an overview of local government funding changes in recent years see: Smith, Phillips, Simpson, Eiser, & Trickey, 2016) the executive committee decided that all outputs from the programme should form a 'legacy' of the project. This meant that outputs from the project must not require any training for practitioners to be able to use them, therefore, if funding for the project was withdrawn, teachers would still have a library of resources to support them developing their pupils' reading. Unfortunately, funding was withdrawn from the project in 2017, however, the collaborative network continues, and teachers continue to have access to the resources developed by the programme.

1.2. The implicit theories of intelligence framework

The principal tenet of the implicit theories framework is whether one understands a trait or situation as fixed or malleable, for example an incremental theory of intelligence can be understood as having the ability to develop or grow one's intelligence. In contrast, believing that intelligence is innate, and no amount of effort and learning will develop it would be described as an entity theory of intelligence (Hong, Chiu, Dweck, Lin, & Wan, 1999). Implicit theories have been associated with a wide variety of domains, for example on peer relationships (Rudolph, 2010), a sense of social belonging (Walton & Cohen, 2014), and intelligence (Hong et al., 1999) amongst others. By their very nature implicit theories are fundamental; we are driven by them but usually unaware of their presence (Chiu, Hong, & Dweck, 1997). An entity or incremental theory of intelligence and the associated behaviours described above are often referred to as a fixed (entity) or growth (incremental) mindset, which is the terminology that will be adopted throughout this thesis (Dweck, 2000; Lüftenegger & Chen, 2017).

1.2.1. Achievement goals

Motivational research in education in the past few decades has been concerned with the concepts of achievement goals. These relate to what the learner's intended outcomes are, for example, do they wish to develop their skills, or achieve a high score on a test (Senko, Hulleman, & Harackiewicz, 2011). These two types of goals are referred to as a *learning goal* and a *performance goal* respectively (Elliott & Dweck, 1988). An individual who has a performance goal seeks positive evaluations of their skills or abilities, whilst avoiding any negative ones. If in a primary school classroom, differentiated work is available (tasks on the same topic with different levels of challenge) then a pupil with a performance goal might opt for an easier task so that they could get everything correct. This would allow them to confirm their level of intelligence as they will achieve a good mark easily. In contrast, a pupil with a learning goal would choose the most challenging task knowing that they wouldn't perhaps get everything correct, but that they might learn new things (Dinger, Dickhäuser, Spinath, & Steinmayr, 2013).

The above describes what is known as the *goal orientation model* within contemporary achievement goal literature and is based on a dichotomy of learning and performance goals (Senko & Tropiano, 2016). Since Dweck (1986) initially posited her *goal orientation model* there have been notable advances which offer a more nuanced view of an individual's achievement orientations. It is critical to recognise these advances, however, as this thesis is based upon the implicit theories framework (Dweck, 2000) the exposition of alternative theories below will focus on how they map onto this framework. The first substantive theoretical development of the *goal orientation model* was put forward by Elliot and Harackiewicz (1996) who proposed a trichotomous model that maintained a learning (or mastery goal) but partitioned performance goals in two: performance approach and performance avoidance. These retained the original perspective that pupils with a performance goal would wish to demonstrate their abilities, however, recognises that this can be motivated by a desire to demonstrate competence (performance approach) or to avoid showing a lack of competence (performance avoidance).

Elliot and McGregor (2001) advanced this model to incorporate approach and avoidance goals into the mastery orientation also, this is known as the *goal standard model*. With "standard" referring to the desired standard (or competence) the pupil wishes to achieve (e.g. 10 out of 10 on a spelling test). The *goal standard model* is described as having competence at its core, being whether the pupil defines that competence as an absolute (i.e. the task at hand), intrapersonal (i.e. a personal best), or normative (i.e. the performance of others) standard which dictates their mastery or performance orientation. Those with an absolute or intrapersonal definition have mastery orientations and normative definitions are associated with performance goals. The model also posits that competence is also construed in terms of valence, with a positive valence (approach) and negative (avoiding failure). In concert, definition and valence provide a 2x2 framework of mastery or performance and approach or avoidance goals.

The parallels between the mastery-approach goal in the *goal standard model* and the mastery goal of the *goal orientation model* are clear. A mastery-approach goal is conceptually related to the competence element of a learning goal in the g*oal orientation model*, making these very similar in the two models. The mastery-avoidance goal is the new addition which the *goal standard model* makes (Elliot & McGregor, 2001). However, it is more challenging to readily align the performance goal as defined in the *goal orientation model* with either approach or avoidance performance goals from the *goal standard model*. Yet, as Dweck (1986) focussed on competence demonstration without a normative component as her definition of a performance goal within the *goal orientation model*. It is conceptually plausible to apply the same logic as above; it is appropriate to assume a performance-approach goal as most closely aligned with the performance goal in the *goal orientation model* given the competence component. The performance-avoidance goal is the new contribution in this model.

A more recent development in achievement goal literature is the *goal complex model* (Elliot & Thrash, 2001; Elliot, 2005). This is an integration of both the *goal orientation* and *goal standard models*. Using the terminology of the *goal standard model,* the *goal complex model* defines goals in the approach form (e.g. a performance goal would produce a desire to outperform others), which is similar to the *goal orientation model*. However, it also recognises that pupils could pursue this type of goal for various reasons, known as the goal reason. Thus, the structure of a goal as either achievement or performance is "ACHIEVEMENT GOAL because REASON". The reason component is the integration of the *goal orientation model* and it is suggested that this reason provides both the impetus for the goal adoption *and* shapes its effects. For example, "MY GOAL IS TO LEARN because OF THE ENJOYMENT I GET".

Elliot and Thrash (2001) described goal reasons as "the *psychological starting point* for action"; that it is the primary feature of the goal complex. When shaping the effect of the goal orientation (learning or performance) goal reasons are broken down into two categories: controlling and autonomous. Controlling reasons are things such as rewards, or impressing others, whereas autonomous reasons are more positive, for example challenge or personal usefulness. These reasons can shape the achievement goal into maladaptive (e.g. help-avoidance) or adaptive effects (e.g. self-efficacy) respectively. There is an unlimited quantity of goal reasons under the *goal complex model* as the model is not limited to a particular set of reasons.

In their narrative review, Urdan and Kaplan (2020) trace the origins and evolution of achievement goal theory. What they make abundantly clear is that researchers in the field have not yet reached a consensus on how goals are defined and the motivations that drive and individual towards these goals (c.f. Senko & Dawson, 2017). It is noteworthy that much contemporary mindset research sidesteps this issue and focusses on a theory of intelligence, presumably as it is assumed to be an antecedent of positive or negative achievement goals (e.g. Yeager et al.,2019). This is despite achievement goals being a conceptually distinct part of Dweck's (2000) theoretical framework. It was beyond the scope of the current research to try to resolve these debates and as highlighted above, achievement goals are one component amongst many in a growth mindset. Therefore, given the context of the current research and the focus on Dweck's (2000) mindset model, the *goal orientation framework* (i.e. learning and performance goals) was adopted.

The decision to adopt this framework was motivated by several reasons. Firstly, the focus of the current research was on novel approaches to the application of growth mindsets in classrooms. This often appears quite distinct from achievement goal research, as the majority of growth mindset studies do not include constructs beyond theory of intelligence (Lüftenegger & Chen, 2017). Secondly, the time pressures on data collection; given the context of the current research, it was important to ensure that the questionnaire did not take too much time to administer. Senko and Dawson (2017) suggest that further research is required to arrive at a parsimonious account of the myriad reasons which shape whether the goal has adaptive or maladaptive educational outcomes. This leaves approach orientated learning and performance goals as a parsimonious and efficient option of capturing a 'global' motivational factor, which would be in-line with the *goal orientation model* approach as described above.

1.2.2. Effort beliefs

Students with a fixed mindset also view effort negatively; firstly, having to apply effort suggests a struggle to complete the task in hand, therefore, their abilities are insufficient. Secondly, in understanding intelligence to be fixed there is no point in applying effort in learning as it will not develop their intelligence (Hong et al., 1999; Tempelaar, Rienties, Giesbers, & Gijselaers, 2015). An avoidance of failure and an unfavourable view of effort results in an avoidance of challenges. Challenges present learning opportunities. Therefore, a fixed mindset can inhibit academic progress (Claro, Paunesku, & Dweck, 2016; Grant & Dweck, 2003). In contrast, a student with a growth mindset views intelligence as something which they are not born with, but which they can develop through learning (Dweck, 2000). To those with a growth mindset, effort is seen as an indicator of learning (Hong et al., 1999). The learning required to fill the gap will require effort to be successful, which is also viewed differently by those with a growth mindset as challenging tasks are an opportunity to develop their intelligence, and the effort signifies that they are developing their intelligence (Elliott & Dweck, 1988).

1.2.3. Response to failure

How individuals respond to failures, large or small, has been associated with their mindset. Two ways in which someone might respond to failure have been identified, these are *mastery* and *helpless responses* (Burhans & Dweck, 1995; Diener & Dweck, 1978, 1980; Dweck & Leggett, 1988). The mastery response to failure associates failure with a lack of effort or appropriate techniques or strategies used. Pupils who display a mastery response to failure often do not see themselves as a failure, but instead see the failure as indicating an area they need to work on. As they identify intelligence as malleable, they believe it possible to improve their performance in this area (Dweck, 2000). This means that individuals will often display higher levels of persistence and a more positive affect following failure if they have a mastery response (Skipper & Douglas, 2012). In contrast, those who have a fixed mindset often display a helpless response to failure. This helpless response is characterised by perceiving their performance as poor (even if it is not), having lower affect following failure, and being less likely to persist at the task (Burhans & Dweck, 1995). As those with a fixed mindset understand their abilities to be fixed, the failure is perceived as having occurred because they lack the fundamental skills to complete the task and their fixed intelligence prevents them from ever acquiring those skills. For example, someone with a fixed mindset would be more likely say something such as “I just don’t have a maths brain”.

Burhans and Dweck (1995) suggest that children with a fixed mindset will often try to justify a failure or disengage from a task to ‘avoid’ the failure. For example, in classrooms, learners are presented with many challenges every day. When learning to read, young pupils are presented with graphemes (letters on the page) which they then must convert to phonemes (letter sounds), and finally all of these must be held in working memory so that the whole word can be produced and meaning derived (Helder, 2014). At every step of this process, which may be decoding a simple word like ‘can’, there is potential for failure. If a pupil had a fixed mindset and could not recognize the grapheme ‘c’ then they may find reasons to discontinue the exercise (i.e. needing to use the toilet), blame their abilities, or experience low mood. Conversely, a pupil with a growth mindset may ask for help on how to correctly decode the grapheme. Their affect would be unchanged by the failure, and they would have appreciated the learning opportunity (Dweck & Leggett, 1988; Nussbaum & Dweck, 2008). Even in this simple example it is clear to see the educational benefits of a growth mindset.

1.2.4. Mindsets and occupational aspiration

Plaks, Levy, and Dweck (2009) theorised that individuals have self- or lay-theories (fixed or growth) about most domains in their lives, such as politics, health, their self-schema, and other people (stereotypes). They suggest that these theories function in a very similar manner, in that they provide a foundational element of social-cognitive processes (i.e. whether these domains are fixed or malleable). Some research has suggested ‘spill over effects’; that when promoting a growth mindset in one domain (i.e. intelligence) individuals adopt a more growth mindset view in other domains (Molden & Dweck, 2006).

As children age, lower academic self-concept and negative stereotypes have been shown to reduce their academic and occupational aspiration (Strand & Winston, 2008). Growth mindsets present a potential remedy to this, firstly in relation to intelligence. If a child holds a growth mindset, they may believe that their intelligence could improve and that they can become clever enough to engage in professions which require high level academic qualifications, such as medicine. This thesis seeks to develop a growth mindset intervention around intelligence. Research would suggest this will also help students be less influenced by negative stereotypes (Aronson, Fried, & Good, 2002). This may help raise pupils' aspirations as they may not feel limited by negative stereotypes or self-schema. This is especially relevant for pupils from lower socioeconomic backgrounds, who may believe that only individuals from higher socioeconomic backgrounds should aspire to 'high level' occupations.

1.2.5. Mindsets are sensitive

There is a substantial body of literature demonstrating that mindsets can be changed (Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018). There are a variety of methods that researchers have employed to achieve this change, with the most frequently employed being feedback and education around neuroplasticity. Mindsets can be influenced by very subtle changes in language and meaning (Cimpian, Arce, Markman, & Dweck, 2007). For example, giving feedback such as, "You are a good drawer" promotes a fixed mindset because it places the emphasis on a trait which the pupil has no control over (Zentall & Morris, 2010). In contrast, a subtle change such as saying "You did a good job drawing" promotes a growth mindset because it suggests that it was the 'job' the child did that resulted in the positive performance. The choices which the pupil makes throughout the 'job' are under the control of the pupil which suggests that they have control and can develop their skills.

Some interventions have been developed in which a schedule of lessons designed to promote growth mindsets were delivered in schools; Blackwell et al. (2007) did just this. They delivered 25-minute sessions to students who were 12 to 13 years of age, once per week for 8 weeks. The sessions covered topics such as physiology of the brain, study skills, and anti-stereotypical thinking. The experimental group also participated in discussions, activities, and read science-based articles about how intelligence is malleable and can be developed. The control group followed a similar programme but had study skills training instead of content which promoted growth mindsets. They found that the intervention successfully promoted growth mindsets. Others have developed internet-based interventions such as Yeager et al. (2016) and Paunesku et al. (2015). Instead of teaching pupils about neuroplasticity in person the messages were delivered via the internet. However, these interventions, whether delivered online or in person share the same flaws; they fail to engage all pupils in the school (or indeed classrooms). This means that they do not create a growth mindset culture in the school, leaving pupils open to fixed mindset messages from other influences in school. This also can mean that effects are short lived and are only found during the intervention itself, rather than leading to lasting change.

1.2.6. Measuring mindsets

There are two main approaches taken when measuring mindsets: having participants engage in a task and observing their persistence and responses to failure, or psychometric instruments. There are three main approaches taken when observing how younger children respond to failure. Firstly, the use of puppets to role play a failure scenario, in which the participant and researcher use puppets and act out several success scenarios and then a failure (e.g. Cimpian et al., 2007; Heyman, Dweck, & Cain, 1992). A similar method, utilising vignettes rather than roleplay, where participants read stories about successes and failures have also been used (e.g. Kamins & Dweck, 1999; Skipper & Douglas, 2012). Other studies have asked pupils to complete tasks such as Raven's matrices or Tangram puzzles with the failure trial being impossible to complete as it is missing a piece or a highly complex task (e.g. Dweck & Reppucci, 1973; Mueller & Dweck, 1998). However, as naturalistic as these methods may be, they are time consuming during their administration and in their analysis, for example coding data observed in puppet tasks.

1.2.7. Mindsets and education

The educational benefits of a growth mindset feel intuitive; pupils who seek out challenging tasks, apply effort, and respond positively when they fail would clearly do better. There is a growing body of evidence to support this. In Chile all pupils in the 10^{th} grade (15-16 years of age) undertake national tests in mathematics and language skills. As part of this testing in 2012 the Chilean government also surveyed their pupils' mindsets and Claro et al. (2016) found 11.8% of variance in composite mathematics and language scores explained by mindsets. They also found that, consistent with prior research, pupils from lower socioeconomic backgrounds (the most at risk of underperformance), benefitted the most from a growth mindset. The studies previously mentioned also report very similar results; for example, Blackwell et al. (2007) showed that pupils with declining performance in mathematics had this decline reversed after receiving their intervention. Paunesku et al. (2015) developed a brief growth mindset intervention delivered over the internet to high school students. Their data showed that a growth mindset raised the rate at which students were satisfactorily performing by 6.4 percent.

As previously highlighted, mindsets are sensitive; subtle changes in feedback can change young children's mindsets (Zhao, Heyman, Chen, & Lee, 2017). Pupils are exposed to a wide variety of stimuli in educational contexts which could change their mindsets, for example, teacher feedback, testing schedules, reward systems, class discussions, and even displays promoting 'excellent' work (as opposed to celebrating learning). Yet most research to date has focussed on external, usually short-term interventions which do not account for pupils' exposure to a variety of stimuli. It would be optimal to engage teachers and schools at large in the process of creating a robust growth mindset culture. However, this is not without its own challenges; within the UK context educators face many pressures, such as an expansive core curriculum and limited resources (Hanson, 2018). Any interventions which aim to engage teachers must recognise these issues, and ideally include them collaboratively, or in a process of co-creation, in the design process. Co-creation allows potential users and stakeholders to offer their insights in an equal design partnership (Mark, Nick, Emmanouil, & Adey, 2017; Phipps, Cummings, Pepler, Craig, & Cardinal, 2016).

1.3. Summary of research questions

The main aim of this thesis was to assess the effectiveness of an intervention designed to make a rich theoretical framework accessible to a wide variety of educational practitioners, therefore enabling them to promote growth mindsets in their pupils. To meet the aims of the Stoke Reads programme the intervention was targeted at Year 1 pupils (5-6 years of age). The existing testing that Stoke Reads carried out provided academic performance data and was paired with the newly developed mindset instrument. There were no developmentally appropriate instruments to measure mindsets, therefore it was necessary to develop an instrument to measure various aspects of a growth mindset in young children, which could be used by teachers and their assistants across a population with diverse literacy abilities. In a multi-agency team, the intervention was co-created to maximize its accessibility and usefulness in the classroom, therefore maximizing its potential impact. This was then trialled across nine schools in the City of Stoke-on-Trent over one year, in conjunction with literacy assessments. From this it was possible to assess how the intervention influenced mindsets and how mindsets influenced academic achievement.

The research questions to be examined in this thesis are as follows:

1. Did the intervention change mindsets?
2. Are mindsets related to academic performance?
3. Does the intervention improve academic performance?

4. Do teachers' mindsets influence how effectively they deliver the intervention?
5. Does school mindset culture influence the effectiveness of the intervention?
6. Is occupational aspiration related to mindset?

1.4. Chapter summaries

Presented below are brief summaries of each chapter.

Chapter 2: Instrument development

As discussed above, there were no suitable instruments to measure mindsets in young children quickly and easily. Therefore, it was necessary to develop an instrument to capture young pupil's mindsets, which was sufficiently simple to administer without requiring training. This chapter describes the development of the Mindset Measure for Young Children (MMYC). It will set out the reasoning behind the selection of specific mindset behaviours which the instrument measures (e.g. achievement goals, response to failure and success, theory of intelligence). Additionally, the response formats and approaches to how the various constructs within the instrument were operationalised. After these initial decisions were made, the instrument was developed and trialled with an adult sample, who also completed an existing adult theory of intelligence instrument (Dweck, 2000) which captures the subject's theory of intelligence. This was done to explore the concurrent reliability of the newly developed instrument. Following this, two rounds of testing with children the same age as those in the intervention were undertaken to evaluate two key aspects. Firstly, whether, with no direct training, researchers from the University could successfully administer the instruments with young children. Their feedback on their experience of administering the instrument was sought to ensure it was as easy to use as possible. Secondly, whether young children understood and engaged with the questions and if their responses were stable over time. The trials revealed that the behaviours which the instrument measured (achievement goals, response to failure and success, theory of intelligence) did not seem to fit together as the literature suggests. Therefore, an additional study was conducted which employed the MMYC items paired with extant instruments. This allowed an assessment of the congruent validity of the MMYC items and whether the framework held together as previously described. Results suggested that this was not the case, critically limited relationships were found between implicit theories of intelligence and other elements of a growth mindset.

Chapter 3: Intervention development

To maximize the potential impact of the intervention, a co-creation approach was adopted. Co-creation is a method of collaborative knowledge generation which involves academic(s) working alongside other stakeholders, with the goal of collective knowledge production, rather than knowledge translation (from expert to practitioner) (Greenhalgh, Jackson, Shaw, & Janamian, 2016). This chapter covers the process used to develop the Stoke Reads Mindset Kit. In the context of the current research project it was important that the intervention be as accessible and relevant to teachers in the classroom. The goal was not to create a condensed literature review, or dense tome, but create a toolkit which offered practical advice and ideas to use in the classroom. To ensure this was achieved, a group of teachers, specialist literacy advisers, speech and language therapists, and academics worked collaboratively to produce the intervention utilising the co-creation approach. This chapter will cover the process and decisions relating to the composition of the ideas and strategies contained within the Stoke Reads Mindset Kit.

Chapter 4: Evaluation of the intervention - Pupils

This chapter evaluates the intervention in relation to the pupils; whether the Stoke Reads Mindset Kit promoted growth mindsets, and if this improved academic performance. As discussed in the current chapter, the research in this thesis was conducted in conjunction with the Stoke Reads group of schools, who already collected literacy data from pupils at the end of Reception and Year 1. As the intervention was developed for use with young children, this allowed us to trial the intervention within the Stoke Reads group; some schools formed the experimental group and others a comparison group. Alongside the literacy tests pupils also completed the Mindset Measure for Young Children. Throughout a full academic year, teachers in the experimental condition were free to utilise the Stoke Reads Mindset Kit as they wished. Teachers in the comparison condition continued with their normal practice.

Chapter 5: Mindsets and aspiration

This chapter begins by highlighting the potential theoretical link between mindsets and occupational aspiration. Next is presented the relationship between mindset and occupational aspiration in young children, both in cross-sectional and longitudinal data from the Stoke Reads Mindset Kit trial. Following this, to explore whether the relationship is clouded by a lack of clear occupational aspiration amongst young children, cross-sectional data from adults is presented. Data are then discussed within extant theories of occupational aspiration development.

Chapter 6: Evaluation of the intervention - Teachers

As teachers engaged with Stoke Reads Mindset Kit and used it to inform their practice it was important to explore whether this had any effect on them. Teachers were surveyed using instruments to capture their personal mindsets, their teaching practices, their view of their classroom culture, and their view of the culture in their school. Teachers in the experimental group also provided feedback on how they used the mindset kit, what they liked and what they wished to see improved.

Chapter 7: Conclusions

This chapter summarises the key findings of this thesis. These findings will then be related to the wider research literature and theory, highlighting the contribution of the current work. The limitations of the research outlined in this thesis and potential directions for future research will also be discussed.

2. Instrument Development

Evidence suggests that young children (i.e. 3 to 6 years old) demonstrate patterns of behaviour that are consistent with those associated with mindsets. For example, young children who are more concerned with performance, as opposed to learning, are more likely to cheat (Zhao, Heyman, Chen, & Lee, 2017). However, much of this research utilises methods of data collection that would be inappropriate for the current research, for example, role play scenarios. A key element of this research was therefore the development of a measure of mindsets for use with young children: the Mindset Measure for Young Children (MMYC). In the current study, data were collected by teachers in schools alongside existing literacy testing which they completed as part of their membership of the Stoke Reads programme. Data collection for this project was combined with the collection of this literacy data; it was therefore vital that data collection was quick and easy for teachers to administer. This chapter will review existing approaches to measurement of mindsets and young children and discuss the development of the MMYC including initial trialling with adults and young children. Unexpectedly results from the development of the MMYC did not support the structure of the theoretical framework as put forward in previous research. For example, implicit theories of intelligence were not related to response to failure. The remainder of the chapter will focus on this and the implications this had on trialling the instrument.

2.1. Theoretical constructs under investigation

The theoretical framework of implicit theories of intelligence proposes several elements which constitute a growth or fixed mindset. These are: learning/performance goal orientation, positive/negative effort beliefs, mastery/helpless responses to failure, and incremental/entity theory of intelligence. Previous research suggests that the core of mindsets are implicit theories of intelligence. If an individual has an incremental theory of intelligence, they will orientate towards learning goals, have positive views of effort, and have a mastery response to failure; in other words, a growth mindset. In terms of learning goal orientation, an individual with a learning goal will seek to engage with learning opportunities which may present challenges but will provide the most opportunities for developing skills and knowledge. In contrast, an individual with a performance goal aims to demonstrate their ability and avoid potential opportunities for failure (i.e. be challenge averse) (Grant & Dweck, 2003). Those with positive effort beliefs understand that applying effort to solve a problem indicates that they are learning and improving their intelligence. Conversely, those who view effort negatively feel that trying hard indicates that they are not clever enough (Dweck & Leggett, 1988). With regards to response to failure, a mastery response is described as understanding that the individual has not 'yet' mastered the skills or knowledge required to complete the task at hand, but that they can in future. This leads to positive behaviours such as persistence and more positive affect following a failure. Those with a helpless response to failure believe that their failure indicates that they are not clever enough to complete the task and that their ability is unlikely to change. This results in catastrophising behaviours following failure, such as negative perceptions of performance and avoidance strategies (Haimovitz & Dweck, 2017).

All of these elements are proposed to stem from an individual's theory of intelligence (Blackwell, Trzesniewski, & Dweck, 2007; Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013). Individuals with an incremental theory of intelligence hold that intelligence is malleable, that they can develop it through effort and education. In contrast, those with an entity theory of intelligence understand intelligence as a fixed trait, that they will never develop the 'amount' of intelligence they were born with (Dweck, 2000). An incremental theory of intelligence allows the individual to seek out challenges (learning goal) because a more challenging task provides a greater learning opportunity which will increase their intelligence. Whereas, an individual with an entity theory would seek to demonstrate their abilities by undertaking easier tasks (performance goal) as with only a set amount of intelligence they need to demonstrate its worth via successes (Elliott & Dweck, 1988). Additionally, those with an incremental theory view the effort required to develop the necessary skills to succeed as part of the learning process and that it signifies that learning is taking place (Tempelaar, Rienties, Giesbers, & Gijselaers, 2015). Yet, those with an entity theory would believe that if they need to work hard at something, they are not clever enough to do it. Finally, incremental theorists maintain positive affect following failure, because they see failure as simply signifying an area on which they need to develop, often persisting at the task until they have mastered it (Skipper & Douglas, 2012). But those with an entity theory often have lowered affect, assume their performance was worse than it was, and do not continue following failure (Mueller & Dweck, 1998). Collectively these cognitions and behaviours are described as a growth and fixed mindsets.

Most of the research exploring the impact of implicit theories in education assumes that theory of intelligence is a key predictor of academic achievement. The suggestion is typically that these implicit theories lead to changes in learning goals, effort beliefs and response to failure and this in turn leads to changes in performance. However, research typically does not measure changes in these different variables or model the path from theory of intelligence through to achievement (e.g. Claro, Paunesku, & Dweck, 2016; Yeager et al., 2016). In adopting such a focus, the role of other elements of the self-theories framework as proposed by Dweck (2000) are often ignored. This is potentially problematic as what little evidence there is does not suggest a direct relationship between implicit theories of intelligence and academic achievement. Arguably there is a dearth of research which has mobilised the full potential of the theoretical framework.

The most notable exception is a meta-analytic review by Burnette, O'Boyle, VanEpps, Pollack, and Finkel (2013) in which they proposed and tested their 'setting/operating/monitoring/achievement model' (SOMA model) – see Figure 1. This was a meta-analytic study and their literature search and inclusion criteria resulted in a large sample size ($N = 28{,}217$; $k = 113$). The SOMA model includes the 'core' components of mindsets, as laid out above. It also includes the approach and avoidance dimension of goal theory (see Grant & Dweck, 2003) and ego threat (see Dweck, 2000); these will be explored in more detail below. As can be seen from the path weights, whilst there is a statistically meaningful relationship between incremental beliefs and goal achievement, this is much smaller than other elements. Indeed, other tests of the framework do not support a direct relationship between implicit theory of intelligence and achievement, rather achievement was predicted by the other elements (e.g. Blackwell, Trzesniewski, & Dweck, 2007). This highlights the need for the current research to incorporate all elements of the theoretical framework in the instrument. This will allow an exploration into the nature of the framework and additionally how a growth mindset is related to achievement within young children.

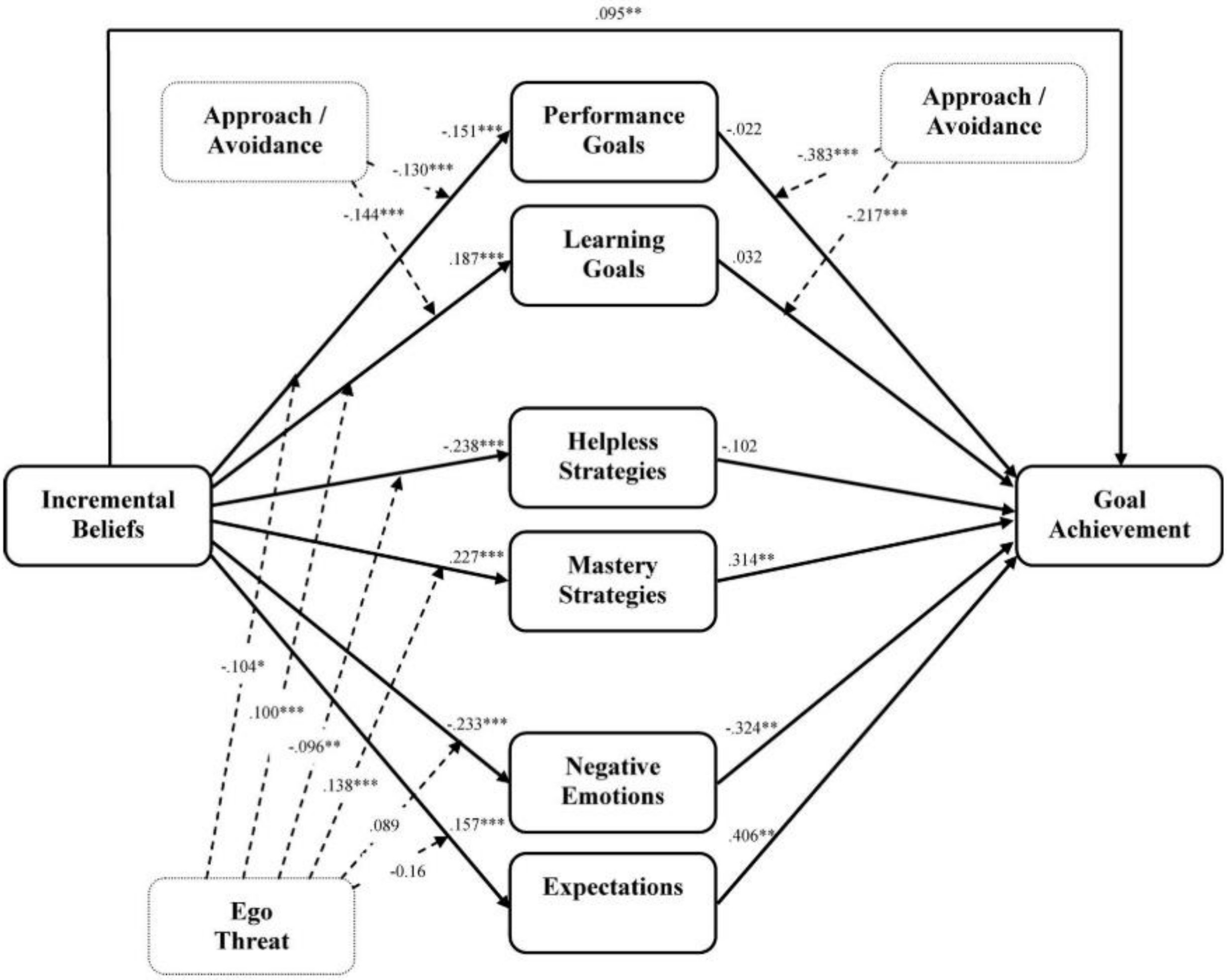

Figure 1. SOMA model meta-analytic results. Effect size estimates for the direct effects (solid lines) are observed correlations (r); effect size estimates for the moderational effects (dashed lines) are regression coefficients (B). Reprinted from "Mind-sets matter: A meta-analytic review of implicit theories and self-regulation" by Burnette, J.L., O'Boyle, E.H., VanEpps, E.M., Pollack, J.M., Finkel, E.J. (2013)

Burnette et al. (2013) state that they were the first to build a model which integrates implicit theories research with self-control theory. The two additional elements beyond the usual components of mindsets were negative emotions and expectations, these originate from self-control theory (see Carver & Scheier, 1982). These two constructs are considered by Burnette et al. (2013) under the broad term of 'goal monitoring'. Negative emotions refer to negative affect a learner would feel if their progress falls below their desired rate of change. It is arguably comparable to the affective response to failure typical in mindset research as it is the recognition of failure over the longer term (e.g. Heyman, Dweck, & Cain, 1992). The construct of expectations is described as an internal (or implicit) indicator the individual holds of their view of the likelihood of them achieving their desired rate of change.

Prior to Burnette et al. (2013) proposing the SOMA model, Blackwell et al. (2007) also tested a structural model of the relationship between the different components of the theoretical framework and academic achievement. Their model proposed multiple-mediated pathways through which pupils increase their academic achievement all of which stem from an incremental theory of intelligence, see Figure 2. The first of these is positive strategies which Blackwell et al. (2007) conceptualised as positive, effort-based strategies, in which pupils would spend more time on subjects or engage more positively in class. This was mediated by learning goals. The model also suggests that incremental theories lead to positive effort beliefs, which directly mediate a relationship to positive strategies. Taken together these two models highlight the necessity of accounting for all elements of the theoretical framework in relation to academic achievement. Both models were found to account for goal achievement, yet Burnette et al. (2013) supported a direct path between theory of intelligence and achievement. However, Blackwell et al. (2007) only suggest that positive strategies influence achievement. Yet, both models place implicit theories at the core of the framework; all other behaviours are reliant upon and influenced by whether the individual has an incremental or entity theory of intelligence.

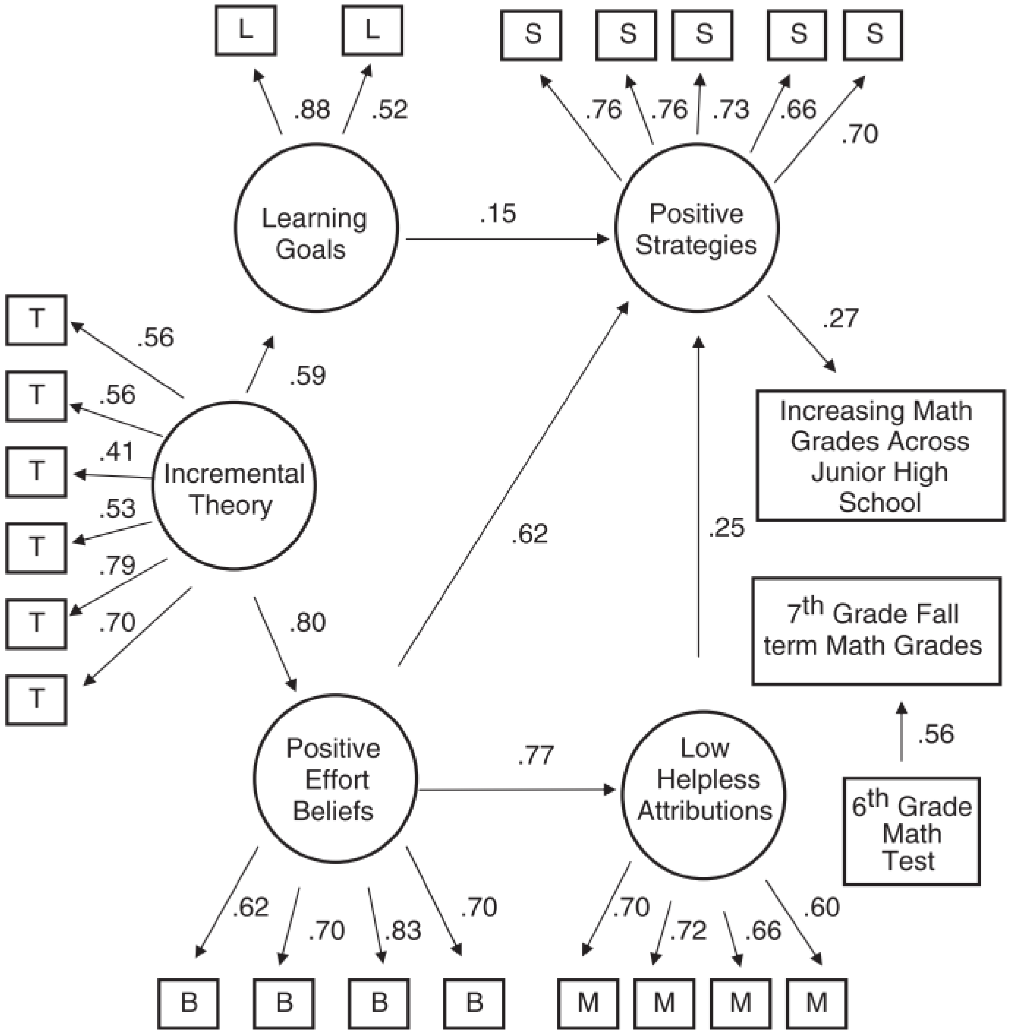

Figure 2. Path model of processes linking theory of intelligence and other motivational variables to mathematics grades. Reprinted from "Implicit theories of intelligence predict achievement across an adolescent transition: a longitudinal study and an intervention" by Blackwell, L., Trzesniewski, K., and Dweck, C. (2013)

2.2. Review of existing approaches to measuring mindsets

This section will consider the different element of mindsets, but the focus of this section is not the theoretical constructs under consideration, rather the techniques employed to measure them. There are few studies investigating mindsets which have directly attempted to engage children the same age as those in the current study as participants. In all these approaches similar questions are asked or scenarios presented. The specific minutiae of the wording of each question for example is not the direct objective of this review. This review will evaluate extant approaches to operationalisation and measurement and consider how they could be used or adapted in the current research. Finally, this section concludes with overall considerations which relate to the delivery mechanism and instructions provided to future test administrators.

2.2.1. Goal orientation

In their seminal paper Elliott and Dweck (1988) first asked children aged 10 to 11 years participated in a pattern recognition task and provided them objective performance feedback in which the child learned they had 'done well' or 'badly'. A second researcher then presented two boxes to participants, which were presented to pupils with the following two verbal descriptions by the researcher:

> "*Performance task*. In this box we have problems of different levels. Some are hard, some are easier. If you pick this box, although you won't learn new things it will really show me what kids can do."
>
> *Learning task.* If you pick the task in this box, you'll probably learn a lot of new things. But you'll probably make a bunch of mistakes, get a little confused, maybe feel a little dumb at times – but eventually you'll learn some useful things." (Pg. 7)

Participants were free to choose which box they chose. Those who chose the learning task were given the task instructions and offered a choice of one of three levels of progressively harder tasks. Results showed that participants who opted for the learning task box chose the more challenging tasks and none chose the hardest task if they had selected the performance task box. Participants were then observed completing the tasks. Elliott and Dweck (1988) were interested in three dependent variables: task choice, problem-solving effectiveness, and spontaneous verbalisations during the task.

This approach could be easily applied in the current research with a few adaptations. Primarily the process would take considerably more time than is available for the testing process in the current research. This approach also requires two researchers to administer the separate elements, the second researcher was blind to the objective feedback the participants were initially given. Having two experimenters was not practical for this research. The provision of equipment (i.e. task boxes and tasks) has both financial and practical implications; for example, the task might get lost or be administered incorrectly. Finally, the recording and coding of spontaneous verbalisations during task completion would be impractical to reliably execute across the varied settings in the current context.

To develop a new protocol to explore learning goals, the descriptions of the tasks could be streamlined whilst still conveying the same messages. To avoid equipment and administrators being required to ‘act out’ the scenario, the scenario could be easily represented on paper. There is a substantial quantity of information presented to participants in the Dweck and Elliot’s (1988) descriptions. The participants in the current research are less likely than 10 to 11-year olds to be able to engage with such descriptions as they require high levels of comprehension and working memory, demands that 5 to 6-year olds may not be able to meet (Castles, Rastle, & Nation, 2018). This also raises an issue in the simultaneous presentation of the two options, it could be too cognitively demanding to expect young children to be able to recall the necessary information about the two tasks, when presented simultaneously, to express a genuine choice.

Measuring pupils' responses to failure is often completed by using Likert style response formats (Corpus, McClintic-Gilbert, & Hayenga, 2009; Kamins & Dweck, 1999). For example, measuring affect towards a learning or performance goal scenario would require pupils to report how happy or sad they felt. Even young children can appreciate differing levels of emotions and demonstrate an awareness of different levels of happiness and sadness (Saarni, Campos, Camras, & Witherington, 2007). It is possible to adapt Likert-style response formats to make it easier for young children to report their emotions (Capik & Gozum, 2015; Greenwald & O'Connell, 1970). The use of 'smiley face' response formats is common within developmental psychology, which involves displaying faces with varying levels of happiness and sadness as anchor points on a Likert-type scale (e.g. Davis, Leman, & Barrett, 2007; Kinlaw & Kurtz-Costes, 2007). However, there is limited research into the additional benefits of using pictorial anchored points in Likert-style response formats. Reynolds-Keefer, Johnson, Dickenson, and McFadden (2009) conclude that there is limited difference between pictorial and text-based anchors and conclude that pictorial and text-based approaches can be used interchangeably. Additionally, they also suggest that if the pictures are closely aligned conceptually to the construct under investigation that they are likely to benefit younger children's engagement with the instrument. If asking children to rate their levels of happiness or sadness adding a ‘smiley face’ could help participants respond accurately, especially those who speak English as an additional language. Finally, research has shown that young children are more able to utilise anchor points which are individually labelled, as opposed to when just the upper and lower bound labelled (Mellor & Moore, 2014). Therefore, asking pupils to rate how they feel about learning of performance goal scenarios could be achieved by enhancing anchor points pictorially and individual labelling each anchor point.

In conclusion, previous research suggests that it is reasonable to ask pupils to make a judgement based upon a learning or performance goal orientated scenario. However, they should be serially, not simultaneously, presented. The examples should be of concrete ‘real world’ tasks that they recognise as a usual part of their education to facilitate pupils giving meaningful preferences in respect of achievement goals. For example, an image of mathematics and spelling problems familiar to pupils of that age could make the task more concrete making it as likely as possible that they could imagine themselves being presented such tasks, thus helping them provide the most meaningful responses. Finally, instead of a dichotomous preference between the scenarios, asking pupils how they would feel (i.e. to what extent they would feel happy or sad) about the scenarios appears to be an appropriate method of approaching the problem. As research suggests that younger pupils can meaningful respond in this manner and it is more in line with their cognitive abilities in terms of understanding the two scenarios.

The MMYC will adopt 'real' scenarios of mathematics and reading questions presented to pupils. These will be set a level appropriate for their age range by a teacher so pupils will be able to clearly see the 'easy' and 'hard' problems. Then a few short sentences will be read to the pupil describing the scenario; that these are 'easy' problems and they will achieve well but learning will be low, and vice versa for the 'hard' problems. Finally, they will be asked how they feel about the scenario and invited to respond using a 'smiley face' response scale.

2.2.2. Effort beliefs

Beliefs about effort have been explored using both psychometric instruments and interview approaches. Nicholls (1978) developed an interview schedule to assess pupil's perspectives on whether effort or ability led to academic success. This was trialled with participants aged 5 to 13 years and required the pupils to be shown short films in which a pupil was either diligently working or completing some work but also spending time on non-work activities (e.g. fiddling with a ruler). Participants were told by researchers that the pupils had both scored 10 out of 10 on their work. Following the film participants were asked four questions:

1. Was one working hard or were they the same?
2. Is one cleverer or are they the same?
3. How come they got the same when one worked hard and one didn't work hard?
4. If they both worked hard would one get more than the other or not?

There are some practical issues with adopting such an approach. Primarily, the films which Nicholls (1978) presented are not publicly available as they were recorded on 8mm film. Therefore, it would require developing new material to show to pupils. It would also require schools in the current research to show pupils such footage. Without providing test administrators with a device on which to play the videos it would impossible to ensure that pupils received the stimuli in a consistent fashion. Even then, such stimuli require time to display and pupils to be encouraged to engage with the material meaningfully; for example, Nicholls (1978) included activities before the video to encourage engagement. Films were also counterbalanced for age and gender which would be impossible to do in the current context. Finally, the free responses would have to be reliably recorded and subsequently coded. However, the questions could provide a useful point from which to develop an approach in line with the constraints of the current research.

A psychometric approach to measuring effort beliefs was employed by Stipek and Gralinski (1996). Participants responded using a 1 to 6 response format (1 = Strongly Agree to 6 = Strongly Disagree). Questions covered five main constructs:

1. Ability is stable and unaffected by effort (e.g. "Some kids will never be smart, no matter how hard they try")
2. Performance is stable and only modestly affected by effort (e.g. "Some kids can never do well in math, even if they try hard")
3. Intelligence is a specific and global cause of academic performance (e.g. "Kids who are not smart don't do well in any subject")
4. Effort is a cause of academic performance (e.g. "Everyone could do well in math if they worked hard")

5. Effort increases intelligence (e.g. "You can get smarter by working hard in school")

There is potentially overlap in the constructs they presented (e.g. between 1 and 2), however, the operationalisation is the main concern of this review. As highlighted by Burhans and Dweck (1995) younger children, may struggle to reflect upon, or indeed even understand, ideas such as effort, or even ability, particularly in a gradated manner. Such suggestions are supported by Piagetian concepts of what young children focus on when grouping objects, in that they group objects based upon physical characteristics. For example, when grouping food items, they are more likely to group them by physical characteristics such as colour and shape, rather than their properties fruit and flavour (for a review see Gelman & Baillargeon, 1983). Younger children frequently think in dichotomous outcomes when considering abstract concepts (Gelman & Baillargeon, 1983; Heyman & Dweck, 1998; Heyman et al., 1992). This presents a potential response format which may be compatible with younger children's ability to respond to the nebulous idea of intelligence – a dichotomous yes or no response format. Research has also suggested that a dichotomous response format is the "gold standard" for response formats with young children as it is the least ambiguous (Mellor & Moore, 2014). This has been utilised by Harter and Pike (1984) in the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children. This instrument measures abstract concepts such as generalised physical and cognitive self-competence, peer acceptance, and maternal acceptance. Therefore, dichotomous response formats may provide a route to measuring abstract concepts such as effort beliefs in young children.

As Dweck (2000) suggests that those with a growth mindset will view effort as a positive; that trying hard is understood as engaging in the learning process which will result in increased intelligence. The MMYC will adopt a dichotomous response format to ask pupils about their achievement. To make this more concrete, and avoid subject preferences, these questions referred to 'doing well in school'. Over two questions pupils were then asked to attribute the success to 'trying hard' or 'being clever'.

2.2.3. Response to failure

The first approach which will be considered is engaging pupils in actual tasks which they may fail. Two articles have been selected for review. First is a seminal article in the development of the self-theories framework by Dweck and Reppucci (1973) in which they utilised the pattern completion element from the Wechsler Intelligence Scale for Children (Wechsler, 1949). This requires participants to recreate a geometric pattern using cubes with blocks which are either solid coloured or have a diagonal split with two colours on it. During the experiment, pupils were shown pictures of patterns and those in the failure condition were provided with blocks which would not allow them to complete the pattern. Participants were rewarded for successes with 'chips' which they could trade in for prizes at the end of the experiment. These chips were used to provide a motivation for pursuing success within the task.

However, there are potential issues in offering young children a token reward as an extrinsic motivator to generate engagement with a task. Firstly, a theoretical issue is that contemporary research suggests that humans are intrinsically motivated to learn and assimilate new information (Ryan & Deci, 2000). Indeed, by offering an extrinsic motivator (i.e. token reward) it is likely that that individual's intrinsic motivation would be reduced (Deci, Ryan, & Koestner, 1999). With respect to measuring responses to failure, changing motivation may lead to different responses to failure as pupils may show more failure-avoidant as opposed to achievement-seeking responses (Covington & Müeller, 2001). As the intention for the instrument in the current research is to access multiple facets of growth and fixed mindsets, utilising a token reward could inadvertently change pupils' responses to elements not related to responses to failure, for example goal orientation. Secondly, there are practical issues with using a token reward to create a sense of realism or engagement with a failure task, for example, it would add additional organisational requirements on teachers and schools. Furthermore, the financial cost of providing meaningful prizes for pupils would be too great.

Other researchers have utilised other tasks which are similarly abstract such as those employed by Dweck and Reppucci (1973). For example, Mueller and Dweck (1998) had pupils complete ten Raven's matrices in which participants are required to identify a missing element which completes a geometric pattern. Using abstract tasks such as these means that the participant is unlikely to know themselves whether they have successfully completed the task or not, making the staged failure feel legitimate. Some previous research, including my own (Garnett, 2015) has used problems which were too hard for the age group of participants to create a sense of failure. Whilst this was successful and had the desired effect, it did not work as intended for pupils who were at either end of the ability distribution. For example, in my research a lower ability pupil demonstrated progressively increasing levels of distress as they failed to solve the mathematics problems and testing had to be aborted. Additionally, a higher ability pupil had completed the problems easily and therefore would not believe that they had failed. Thus, creating a sense of failure can be challenging as the task must not cause distress or be too simple. Abstract tasks are therefore more likely to provide a reliable failure scenario. However, these abstract tasks may not be meaningful to pupils and may, to young children, seem like a 'game' which may make the response to failure less genuine.

To overcome the issues discussed above it would be logical to consider another approach that has been utilised in studies of responses to failure which is an imagined failure. Often these are based upon the process employed by Heyman, Dweck, and Cain (1992) in which participants enacted stories about a task in which they failed using puppets. Heyman, Dweck, and Cain (1992) argue that the use of puppets ensures that participants felt engaged in the task and uninhibited to provide honest responses as responses were provided via the role-play scenario, thus, capturing meaningful responses from participants. A similar process was employed by Kamins and Dweck (1999) and Cimpian et al. (2007); participants were familiarised with role playing using the provided puppets. Then a scenario in which the pupil successfully completes several tasks is described and followed by a scenario in which they make a simple mistake, for example Cimpian et al. (2007) told participants that they omitted the ears from a drawing of a cat. Critically, all the tasks were tasks that pupils were familiar with and would engage in on a regular basis. Using puppets helped children to picture themselves taking part in these tasks and failing themselves, thus making the failure authentic.

All the failure scenarios are presented using a verbal vignette. This is potentially problematic for the age of children who will participate in the current research. For example, in Kamins and Dweck (1999) pupils were read the following:

> One day you played with the blocks and built a great big tower. When playtime is over, the teacher, Mrs. Billington, says, "Will you stack up the blocks for me?" and you say "OK, teacher." And so you start to put the blocks over where they are supposed to go, and you begin stacking them up. You really want to do a good job, but when you look down at what you did, you think to yourself, "Uh-oh, the blocks are all crooked and in a messy pile," but you worked hard to put them all away, and you say to the teacher, "Mrs. Billington, I put the blocks away." The teacher looks at the job you did and says, "The blocks are all crooked and in one big mess." (p.838)

There are many reasons why some pupils may struggle to listen to, comprehend, and provide a meaningful response to a passage of that length. For example, pupils who are younger, speak English as an additional language, or even are tired may not be able to listen to and respond to a story of this length (Castles et al., 2018). Therefore, it would seem more appropriate to provide visual examples of the mistakes. The easiest mistake to pictorially represent would be a drawing, for example as in Cimpian et al. (2007) - missing ears from a cat drawing. Providing children with pictures which look realistic, i.e. they could have been drawn by a child of their age, will also increase the likelihood of pupils providing meaningful responses to the stimuli. Within the context of the present study it would not be possible to ask teachers and pupils to engage in role play as part of the study. Primarily this is because it would not be possible to train all individuals who would be administering the tests, potentially generating an unacceptable level of variability in testing procedures between schools or even participants. Secondly, the time required to complete such role play based activities would be too high.

Many studies have employed a ‘real-life’ failure scenario such as a tangrams (e.g. Park, Rosenberg-Kima, Rosenberg, Gordon, & Breazeal, 2017) and Raven’s matrices (e.g. Bempechat et al., 1991); an actual task which the children take part in. I have previously attempted to create age-appropriate mathematics problems for pupils which were intended to be impossible to complete. The spectrum of mathematics abilities even within a single classroom makes this approach highly impractical. Additionally, the time required for pupils to work through problems would increase the time required to complete the current measure beyond what educators would tolerate in the context of the current research. Therefore, the MMYC will make use of imaginary scenarios, including a short vignette (at most two sentences), with clear images depicting the ‘failure’ or tasks the pupils were to be presented with. It is impossible to develop a task (e.g. mathematics, drawing, spelling) that all pupils would equally wish to engage in. Therefore, it was decided that drawing would be the task chosen. It was assumed that most children would not object to drawing. Additionally, and most importantly, the mistake would be very easy to spot, thus making the sense of failure meaningful.

2.2.4. Theory of intelligence

Many of the concepts under investigation have been measured using traditional psychometric approaches. There is a clear precedent set by previous researchers for using psychometric instruments when investigating theory of intelligence with older children (Dweck, 2000). However, there are potential issues with such approaches which require addressing in relation to the type of questions that can generate reliable and meaningful responses from younger children. Primarily, it is important to consider in parallel what children can realistically conceptualise and their ability to translate this into a selection using a gradated response format.

Many previous instruments used in research into mindsets have adopted a 1 to 6 Likert-type response format, from 1 = Strongly Agree to 6 = Strongly Disagree linked with items such as “You only have so much intelligence and you can’t really do much to change it”. This is problematic for young children. Firstly, it is unlikely that they would have a clear definition of ‘intelligence’ as it is not likely to be in their vocabulary yet. Secondly, they are unlikely to be able to conceptualise their agreement and disagreement, nor rate their strength of it. Indeed, Dweck (2000) suggests that 10 years of age is the lower limit for ‘Theories of Intelligence Scale (children)’.

One potential method for avoiding response format issues is that of open response formats, with responses subsequently coded by researchers. Bempechat, London, and Dweck (1991) asked participants aged 5 to 10 years old: "Some kids say you can get smarter and smarter all the time. Other kids say you're a certain amount smart and how smart you are stays pretty much the same. Which one do you agree with?". Results were coded into dichotomous growth or fixed categories. However, researchers have highlighted how the approach of coding responses may require a team of coders and a process which is consistently revised to ensure accurate coding (Hruschka et al., 2004). Furthermore, in respect of trying to ensure an optimal balance between detail and administration time, the potential of such an approach taking too long to administrate is high. This may be for many reasons, firstly, because administrators may have to encourage meaningful responses from pupils and indeed, these prompts if not scripted may impact children's responses. Secondly, the act of transcribing pupils' responses could be time consuming and invite inaccuracies owing to time constraints on educators. It would be unwise to assume that administrators would be as concerned with accuracy and detail as trained researchers. Additionally, verbalising their responses could prove too cognitively challenging for the younger pupils in the current research.

Theory of intelligence is arguably the most complex theoretical construct from the self-theories framework to measure in young children. It is not likely that young children would have a concrete understanding of the word 'intelligence'. Whilst there is no research to support this hypothesis it is reasonable to assume that as "clever" is a higher frequency word in wider use than "intelligence" and therefore more likely to be in their primary caregivers vocabulary and therefore may be better to use in measures for children (Brysbaert & New, 2009; Hoff, 2003). Additionally, this was discussed with teachers in the early stages of instrument development and they suggested that 'clever' was a more age appropriate word and in use by them and their pupils. To reduce the cognitive demand of conceptualising 'cleverness' whilst simultaneously being asked to conceptualise and engage with an agree to disagree response format a dichotomous yes/no question was posed for these constructs. Previous research has suggested that this format can increase accuracy in responding in young children especially when reflecting on past evidence and their own opinion simultaneously (Rocha, Marche, & Briere, 2013).

Finally, the MMYC will include a 'self' and 'others' version of the theory of intelligence element; as suggested by De Castella and Byrne (2015) instruments that focus on the self are more predictive of achievement. They achieved this by changing items from "You have a certain amount of intelligence…" to "I don't think I personally…". Additionally, as the current research aims to generate growth mindset cultures in classrooms it is appropriate to measure whether there are any changes in pupils' views of their peers potential.

2.2.5. Aspiration

In the current research occupational aspiration is understood as the pupil's desired future form of employment. There is a consistent and applicable approach to measuring young children's occupational aspiration; a single free response question "What do you want to be when you grow up?". This has been used by Trice (1991) with children aged 4 to 6 years; they report that 74% of children reported a 'real' career choices, as opposed to fantasy or vague responses.

Furthermore, they found that 46% of participants stated the same career at a second interview eight months later. This question was adopted in the Millennium Cohort Study (Flouri, Moulton, & Panourgia, 2012), but was further enhanced by utilising the Office for National Statistic's Standard Occupation Classification Framework (Office for National Statistics, 2000). The Framework categorises responses by nine major groups, in order of 'aspirational' level:

1. Manager and Senior Official
2. Professional Occupations
3. Associate Professional and Technical Occupations
4. Administrative and Secretarial Occupations
5. Skilled Trades Occupations
6. Personal Service Occupations
7. Sales and Customer Service Occupations
8. Process, Plant and Machine Operative
9. Elementary Occupations

The Framework will need to be extended to include elements that younger children are known to respond with, such as 'fantasy' (e.g. "I want to be a dragon"), and 'do not know'. Utilising such a framework will mean there is not a large burden of coding the data following. Therefore, owing to established effectiveness and simplicity in administration this approach will be adopted.

2.2.6. Overall considerations

The decision on which is the most appropriate approach to measurement must be taken in parallel with which theoretical constructs are to be investigated. Some constructs are more amenable to survey-based measurement and indeed a Likert-style response format. For example, affect following failure or feelings towards completing a task would directly map onto a 'smiley face' response format. There is some work that supports the notion that even young children can effectively utilise a Likert-style response format, especially when the response anchors are not abstract (i.e. not agree to disagree but instead 'happy' to 'sad') (Chambers & Johnston, 2002; Mellor & Moore, 2014). Importantly, the current work will attempt to make the concepts under investigation as concrete and relevant to pupils as possible. It will achieve that through providing clear and readily accessible scenarios to participants. Harter and Pike (1984) presented the 'Pictorial Scale of Perceived Competence and Social Acceptance for Young Children' in which they suggest that pictorial representations of abstract concepts make them more concrete for young children. Wherever possible in the MMYC this will be utilised, both on response formats and in the stimuli presented for each item. As pupils may not be familiar with using a Likert-style response format a practice round of questions will also be developed.

In respect of making the administration of the instrument as accessible as possible for young children Marsh, Craven, and Debus (1991) suggest that it is possible to successfully test complex concepts with young children via one-to-one administration of tests in which the administrator reads out the items. In doing so the administrator can pay attention to the participant and recognise if they require any additional support in understanding the items. This approach will be adopted in the MMYC. As the Stoke Reads group of schools complete literacy tests on a one-to-one basis no additional resources would be required to administer the MMYC in parallel.

2.3. Current research

The initial items were developed by the researcher, these were then passed to academic colleagues and early years reading specialist teachers for comments. All feedback was collated by the researcher and the resultant first draft of the instrument was then trialled. Initially trialling was completed with adults alongside an existing theory of intelligence instrument to explore whether both instruments had convergent validity (Study 1). It is important to highlight that the team expected the MMYC to have strong internal consistency and all items would correlate together as predicted by theory (Dweck, 2000; Blackwell et al., 2007; Burnette et al., 2013). However, this was not the case which will be explored throughout this thesis. Revisions were made as some items were considered too complex for children to access. The revised version was then trialled in a primary school over two time points (Study 2). There were three objectives to the primary school trialling: firstly, to provide stability data for the instruments. Secondly, to assess whether participants could access the measures. Thirdly, to gather usability feedback and recommendations from administrators. Finally, Study 3 carried out further testing with adults to investigate how the constructs within the framework related to each other using both the MMYC and existing instruments.

2.4. Study 1

This study presents the initial trialling of the instrument. To investigate whether the MMYC is capturing the desired psychological constructs it was necessary to administer it in parallel with existing instruments. adults were the sample in this study for two main reasons. Firstly, there are suggestions in the literature that adults have a more stable theory of intelligence than young people (Dweck, 2000). Therefore, any unexpected results would not be attributable to an individual's theory of intelligence developing. Secondly, there are more psychometric approaches to measuring an adult's theory of intelligence which are direct as opposed to interviews or failure tasks. Adults therefore completed existing validated measures of theory of intelligence and the MMYC to see if the questions and constructs mapped together as expected; i.e. that the MMYC had sufficient convergent validity. As highlighted in the initial review presented in this chapter there are two differing models of the relationships within the implicit theories framework by Bunette et al. (2013) and Blackwell et al. (2007). The SOMA model proposed by Burnette et al. (2013) will be the adopted basis on which the structure of the MMYC will be tested. The reasons for this are twofold; their model suggests that all associated constructs (goal orientation, effort beliefs, response to failure) are directly related to an individual's theory of intelligence whereas Blackwell et al. (2007) proposed a multiple mediated model. Additionally, data used to produce the SOMA model is meta-analytical, thus the weight of evidence provided by Burnette et al. (2013) is substantially greater.

2.4.1. Method

2.4.1.1. Participants

Ethical approval was gained from Keele University (see Appendix A). Participants were recruited from two sources: undergraduate students were recruited in exchange for course credits (N = 24; M_{age} = 18.52 years; SD = 1.80; range = 18 to 27 years of age; 19 females), and participants were recruited via the online job site MicroWorkers.com in exchange for $0.50 (N = 65; M_{age} = 36.78 years; SD = 10.74; range = 18 to 55 years of age; 29 females). Restrictions were placed on participants signing up online, they had to speak English natively and be over 18 and from a WEIRD (Western, Educated, Industrialised, Rich, and Democratic) society (Henrich, Heine, & Norenzayan, 2010). This was to ensure that there was no significant cultural variation between the online and university sample. These two samples were combined (N = 89; M_{age} = 31.87 years; SD = 12.34; range = 18 to 55 years of age; 48 females). Information and consent were captured in the first screen of the online survey.

2.4.1.2. Materials

Materials presented below are the initial draft with the final version at the end of this chapter. These two versions are provided to give the reader an appreciation of the development process of the instrument rather than every single iteration. All materials are presented in full in Appendix B. For ease of understanding, questions are grouped under each psychological construct which they are measuring. Several response formats are used in the instrument, as they are used in different elements and to avoid repetition, they are outlined here and referred to below.

Firstly, the ‘smiley face’ response format (see Figure 3).

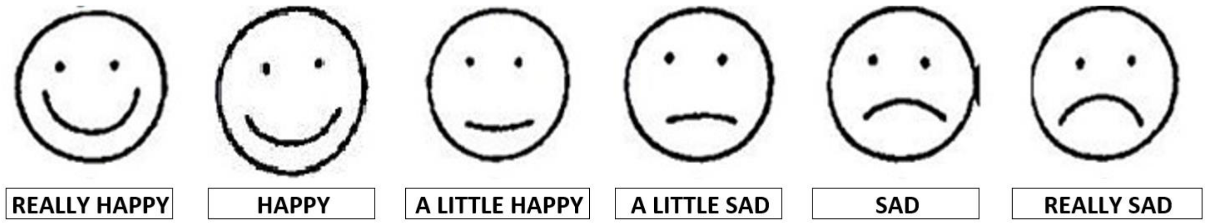

Figure 3. ‘Smiley face’ response format.

Secondly, the yes/no dichotomous response format (Figure 4).

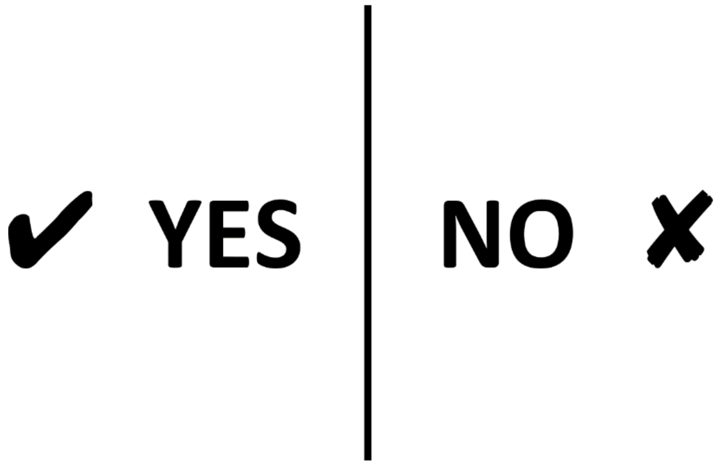

Figure 4. Yes/no dichotomous response format.

2.4.1.2.1. Question 1 through 6 – Theory of Intelligence

These questions were taken from the seminal Implicit Theory of Intelligence Scale from Dweck (2000). As the name suggests, this instrument is designed to measure an implicit theory of intelligence. It contains the following items:

1. “You have a certain amount of intelligence, and you can’t really do much to change it”
2. “No matter how much intelligence you have, you can always change it quite a bit”

3. “Your intelligence is something about you that you can't change very much”
4. “You can learn new things, but you can't really change your basic intelligence”
5. “No matter who you are, you can change your intelligence a lot”
6. “You can always greatly change how intelligent you are”

To which participants respond using Likert-style response format (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Mostly disagree).

2.4.1.2.2. Question 7 – Theory of Intelligence

This question asked participants “Please complete the following equation – Intelligence = ___ % effort and ___ % intelligence”. This was used a proxy measure for theory of intelligence. It did not use the smiley face or yes/no response format but required participants to write two figures into the two box which equalled one-hundred.

2.4.1.2.3. Question 8 - Aspiration

This question asked participants: ‘What do you want to be when you grow up?’ and allowed a free response, meaning however they responded was captured.

2.4.1.2.4. Questions 9 and 10 – Learning and Performance Goals

These two questions are based on images depicting ‘hard’ and ‘easy’ problems (see Figure 5) and utilise the smiley face response format (see Figure 3). The images are examples of three maths and three spelling questions. These were designed in conjunction with a teacher so that all pupils, regardless of ability, would be able to recognise the difference in difficulty between the two sets of problems. The participant was shown the 'easy' task sheet (see Figure 5) and asked "Let's say that the things to do in this picture are really easy, you will probably get them all right but you probably won't learn anything new. How would you feel about doing these?". Participants were then invited to respond using the smiley face response format (see Figure 3). This process was then repeated for Question 10 but using the 'hard problems' (see Figure 5) "Let's say that the things to do in this picture are really hard, you will probably get some of them wrong, but you will probably learn new things. How would you feel about doing these?".

Reptile	?
Disappear	?
Dripped	☑

Cat	☑
Sat	☑
Mat	☑

12 + 5 = 17	☑
20,21…	?
16 – 6 =	?

1 + 1 = 2	☑
1,2,3,4,5	☑
2 – 1 = 1	☑

Figure 5. 'Hard' and 'easy' problems, these are combined for this figure but are separate pages in the testing materials.

2.4.1.2.5. Question 11 through 16 – Theory of Intelligence

These questions are verbal questions without pictorial prompts. Participants were asked to respond using the yes/no response format (see Figure 4). The written and pictorial yes/no response sheet was included as a method to focus younger pupils' attention by requiring them to read the response options and physically indicate their choice by pointing. Question 11 asks "Are some people born clever?" this question is designed to assess pupil's essentialism in relation to intelligence. Question 12 asks "Can they change how clever they are?" this question is designed to measure pupil's theory of intelligence for 'others'. Followed by Question 13 that accesses 'self' theory of intelligence by asking "Do you think that you can change how clever you are?". Question 14 was designed to see whether pupil's understood learning as able to develop their intelligence and asked "If you learn something new does that make you more clever?". As some pupils may consider intelligence as 'doing well in school' both Question 15 and 16 investigated pupil's theory of intelligence in relation to this, but from the perspective of effort in Question 15 "Let's say you are doing well in school. Do you think that is because you are trying really hard?" and in terms of attribution in Question 16 "Let's say you are doing well in school. Do you think that this is because you are really clever?".

2.4.1.2.6. Question 17 through 20 – Reponses to Failure and Success

These questions ask participants to consider two pictures, one of a cat which is missing a tail and a house which is drawn 'correctly' (see Figure 6). They are introduced by the experimenter as such - "Let's pretend that you drew these drawings in art class. You made no mistakes when you drew the house, but when you drew the cat you made a mistake and forgot the tail.".

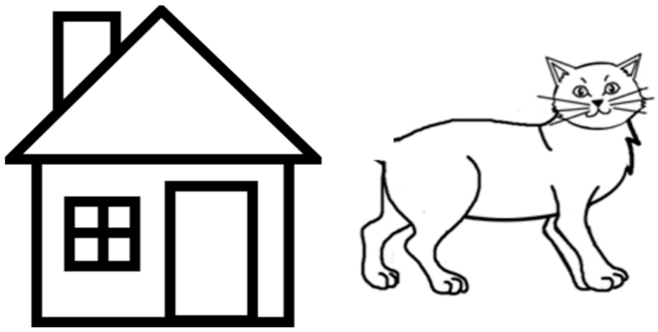

Figure 6. The ‘correct’ house and ‘incorrect’ cat drawings.

The participant was then asked Question 17 “How happy do you feel about your drawing of the cat that you got wrong?” and is invited to respond using the smiley face response scale (see Figure 3). Question 18 aimed to then investigate persistence following success by asking “If you got the chance to draw one of these again, how happy would you feel about drawing the house that you got right?”. And oppositely, but targeting persistence following failure Question 19 asked “If you got the chance to draw one of these again, how happy would you feel about drawing the cat that you got wrong?”. Finally, Question 20 investigated pupils’ willingness to persist in practicing the global skill of drawing, regardless of failure or success and asked: “How would you feel about practicing your drawing the next day?”.

2.4.1.3. Procedure

Undergraduate participants were recruited via an online research participation management system. Online participants were recruited via the MicroWorkers.com website. In both scenarios following sign-up participants were directed to the Qualtrics platform. They were first presented with information about the study and asked to provide their consent to participate. Participants were not told that they would be using instruments designed for children, just that the study would use “different approaches to measuring growth mindsets”. Following this the instruments were presented in the above order finishing with a debriefing which explained the theoretical motivation behind the study.

2.4.2. Data analysis strategy

To avoid repetition the details of the software used to perform analyses will be presented here but were used across all three studies reported within this chapter. Analyses were completed within the R software environment (R Core Team, 2016) and also JASP (JASP Team, 2018); code for the analysis within R is presented in Appendix C. Unless otherwise stated all statistics were completed within the Bayesian framework, with a uniform prior. That is a prior probability distribution which assumes that all potential outcomes are equally likely (Höge, Wöhling, & Nowak, 2018; Van de Schoot et al., 2014). Descriptive statistics were calculated using the *dplyr* package within R (Wickham, François, Henry, & Müller, 2018). Internal consistency and reliability statistics were calculated with the *userfriendlyscience* package within R (Gjalt-Jorn Ygram Peters, 2018). Histograms, principal axis factoring and exploratory factor analysis were completed using the *psych* package within R (Revelle, 2018). Structural equation modelling was completed within the *lavaan* package in R (Rosseel, 2012). Network analyses were completed within JASP and utilised partial correlation and adaptive LASSO regularisation as data were not continuous (Epskamp, Borsboom, & Fried, 2017; Epskamp & Fried, 2016; JASP Team, 2018).

Correlation matrices were compiled in JASP and utilised a Pearson product moment correlation coefficient (JASP Team, 2018).

The research questions addressed in this study are:

1. Does the MMYC form a single, statistically meaningful factor? (i.e. do the constructs all relate to each other)
2. Is there convergent validity between the MMYC and Dweck's (2000) theory of intelligence instrument?

2.4.3. Results

Descriptive statistics for Likert-style response format questions are presented in Table 1 below. This also includes internal instrument reliability statistics. As suggested by Bendermacher (2010) and Peters (2014) Cronbach's alpha (α) is a poor measure of internal reliability. Therefore, in addition, coefficient Omega (ω) and the greatest lower bound (glb) are also provided. Descriptive statistics for dichotomous 'yes/no' questions are presented in Table 2 below. As these data are dichotomous only counts and percentage of responses are provided. However, the alpha, omega, and greater lowest bound reported in Table 1 include all items. The Dweck (2000) instrument has acceptable internal consistency statistics, however, the MMYC does not. There are two potential reasons for this; firstly, there may be poor tau-equivalence (i.e. equal item variance – see Graham, 2006). However, both Omega (ω) and glb are both robust to this and can accept multiple response formats in a single scale. Therefore, it is possible the relationships between the constructs within the framework as put forward by Dweck (2000) were not present. However, it is impossible to draw this conclusion from these results without further investigation.

Table 1.
Descriptive statistics for 'smiley face' response format questions.

Measure	Q	Mean	SD	SE	L95% CI	U95 % CI	α	ω	glb
Dweck ToI	1-6	23.19	6.61	.70	21.82	24.56	.89	.88	.95
Effort Percent	7	51.13	21.08	2.23	46.76	55.51	-	-	-
Performance Goal	9	3.33	1.22	.13	3.07	3.58			
Learning Goal	10	4.36	1.15	.12	4.12	4.60			
Failure – affect	17	3.02	1.18	.12	2.78	3.27	.45	.52	.66
Success – persistence	18	3.10	1.31	.14	2.83	3.37			
Failure – persistence	19	4.38	1.26	.13	4.12	4.64			
Global persistence	20	4.34	.95	.10	4.14	4.54			

Table 2.
Descriptive statistics for dichotomous 'yes/no' questions.

Measure	Q	Count 'yes'	Percentage 'yes'
Are some people born clever?	11	11.24	10.00
Can they change how clever they are?	12	78.65	70.00
Do you think you can change how clever you are?	13	76.40	68.00
If you learn something new does that make you more clever?	14	62.92	56.00
Let's say that you are doing well in school. Do you think that is because you are trying hard?	15	73.03	65.00
Let's say that you are doing well in school. Do you think that is because you are really clever?	16	43.82	39.00

Histograms of data and distributions are presented in Figure 7 below. As can be seen from the histograms there are no significant outliers or unexpected patterns in the data. Whilst data are not normal, for most items this is an attribute of their measurement (i.e. low-resolution Likert-type response format), this is not a concern as data will be analysed within the Bayesian framework (Kruschke, 2015).

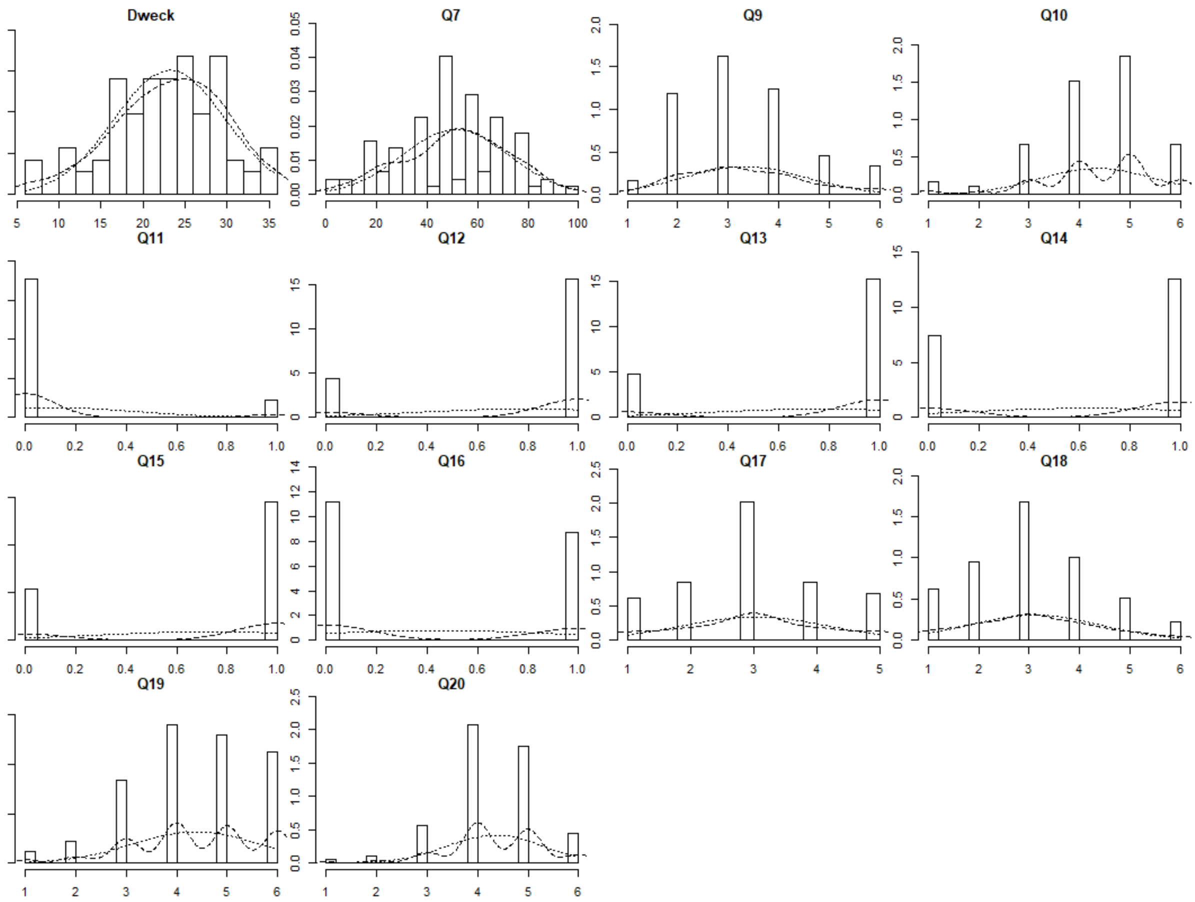

Figure 7. Histogram of all variables. Dotted line = normal distribution. Dashed line = density.

To ensure the Dweck (2000) instrument was producing cohesive and meaningful data to which the MMYC can be compared to its psychometric properties were interrogated. Principal Axis Factoring (PAF; oblique rotation) indicated that the six items from the Dweck (2000) instrument loaded onto one factor, but only explained 57% of variance. According to Beavers et al. (2013), 75-90% of variance should be accounted for, however, over 50% may be acceptable; for such a widely used instrument it was surprising the variance explained was on the lower end of acceptable. The lower than expected percentage of variance explained was further investigated using Exploratory Factor Analysis with items statistically selected based upon Eigenvalues. Therefore, allowing as many factors to be located as best describes the data, meaning that each item is free to contribute to as many factors as it provides meaningful variance towards. This was set to the Kaiser criterion (i.e. Eigenvalues equal to or greater than 1) (Yeomans & Golder, 1982). Oblique rotation was used. These results demonstrate that a single factor meaningfully explains the structure of these data (see Table 3). Therefore, a single factor will be assumed for the Dweck (2000) instrument.

Table 3.
Factor loadings of Dweck (2000) instrument (EFA).

	Loading	Uniqueness
You have a certain amount of intelligence, and you can't really do much to change it (Q1)	.721	.480
No matter how much intelligence you have, you can always change it quite a bit (Q2)	.632	.600
Your intelligence is something about you that you can't change very much (Q3)	.869	.245
You can learn new things, but you can't really chance your basic intelligence (Q4)	.700	.509
No matter who you are, you can change your intelligence a lot (Q5)	.862	.256
You can always change how intelligent you are (Q6)	.730	.467

The same procedure was completed on the MMYC. All items were combined into a single factor as Dweck (2000) suggests they are related, this explained 17% of the variance. However, this lower level of variance required further investigation. Exploratory factor analysis was again set with the Kaiser criterion (Yeomans & Golder, 1982). This suggested a single factor (see Table 4), however, only three items meaningfully loaded, meaning they returned loadings above .30 (Kline, 2002).

Table 4.
Factor loadings from EFA.

	Loading	Uniqueness
Can they change how clever they are? (Q12)	.862	.256
Do you think that you can change how clever you are? (Q13)	.816	.335
If you learn something new does that make you more clever? (Q14)	.653	.574

These results suggest that the strongest component of the model proposed by Dweck (2000) is theory of intelligence but there seems to be very limited overlap between the other constructs. Perhaps this is to be expected as the remaining items are distinct constructs in their own right. However, it was important to explore how these constructs related to one another. As it was expected that all items would load onto a single factor to some degree as is suggested in the literature (e.g. Dweck, 2000 and Burnette et al., 2013).

To begin, a correlation matrix was produced, the results of which are shown in Table 5. The most striking finding is how there is no relationship between the Dweck (2000) instrument and learning or performance goals. This a primary tenet of the theoretical framework (Dweck, 1975; Dweck & Leggett, 1988; Elliot & Dweck, 2005). However, there is a strong relationship between the Dweck (2000) instrument and the other 'pure' theory of intelligence items from the MMYC ("Can they change how clever they are?" and "Can you change how clever you are”). There is also a statistically meaningful, but not overly strong correlation with the persistence following failure item. As Table 6 shows, there are strong relationships between the dichotomous mindset questions suggesting they are all accessing the same psychological construct. However, there are limited other relationships between the constructs. Except between affect following success and performance goals, this is as expected according the framework. Also, between the two persistence items suggesting that a willingness to develop skills is a distinct construct.

Table 5.

Correlation matrix.

		Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Dweck ToI	1-6	—													
2	Effort Percent	7	.51 ***	—												
3	Performance goal	9	.00	.09	—											
4	Learning goal	10	.06	.19	-.13	—										
5	Essentialism	11	.21	.22	.11	-.02	—									
6	Mindset others	12	.51 ***	.30	.00	-.10	.01	—								
7	Mindset self	13	.56 ***	.33 *	-.03	-.06	.03	.74 ***	—							
8	Learning increase	14	.35 **	.28	-.04	-.04	-.10	.58 ***	.51 ***	—						
9	School effort	15	.01	.01	.00	.01	-.27	.05	.14	.22	—					
10	School clever	16	.14	.29	.17	.04	.12	.07	.12	-.26	-.03	—				
11	Failure - Affect	17	.11	.09	-.28	-.14	.02	.15	.10	.05	-.12	-.04	—			
12	Success - Affect	18	.05	.08	.47 ***	-.02	-.06	.18	.13	.01	-.07	.26	-.14	—		
13	Failure - Persistence	19	.32 *	.16	-.05	.15	-.17	.27	.28	.25	.13	.00	-.08	.06	—	
14	Global persistence	20	.17	.13	-.13	.24	-.01	.06	.11	.05	.14	.04	.01	-.17	.43 ***	—

N.B. * $BF_{10} > 10$, ** $BF_{10} > 30$, *** $BF_{10} > 100$.

Network analysis was then used to explore how the different constructs related to each other. This approach is different from structural equation modelling as used by Burnette et al., (2013) and Blackwell et al. (2007) in that the relationships between variables are not prespecified. All variables are represented by 'nodes' and all combinations of relationships between variables are tested with the most parsimonious being selected. The strength of relationships is highlighted by the density of the line connecting them in the network model, and in the matrix output.

In the first step, a network was constructed to examine the relationships and closeness of theory of intelligence instruments (see Figure 8), in which 5 out of 10 possible nodes were meaningfully related. Network weights are presented in Table 6. Firstly, the belief that effort is a key component of intelligence (Question 7) is related to the Dweck (2000) instrument. This is unsurprising as it is an established approach to capturing theory of intelligence. Secondly, the network and correlation analysis above suggest that it is possible to use a single item dichotomous question to measure this construct as in Question 13 ("Can you change how clever you are"). Third, that whilst there is a meaningful relationship between Question 12 ("Can they change how clever they are") and Question 13 as suggested by the correlation analysis above and this network analysis. However, Question 12 has a weak relationship with the Dweck (2000) instrument. This is perhaps unsurprising as the Dweck (2000) instrument is in a 'self' form and Question 12 is in the 'other form. Fourth, there is no relationship between the belief that developing intelligence as in Question 14 ("If you learn something new does that make you more clever") and the two self-forms of theory of intelligence – Question 13, Question 7, and Dweck (2000) instrument.

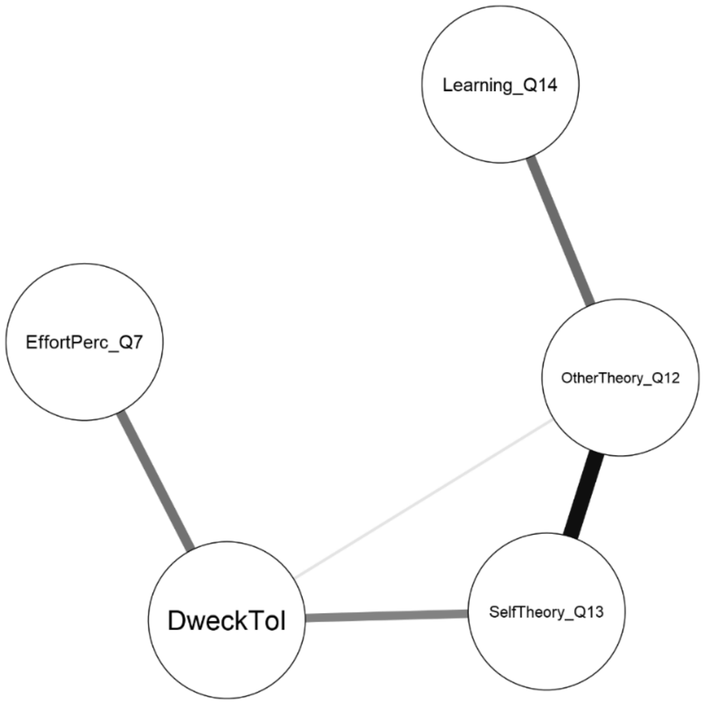

Figure 8. Network of theory of intelligence instruments.

Table 6.
Weights matrix for network analysis of theory of intelligence constructs.

	Q	1	2	3	4	5
Dweck ToI	1-6	-				
Effort Percent	7	.34	-			
Learning increase	14	.00	.00	-		
Mindset others	12	.06	.00	.36	-	
Mindset self	13	.30	.00	.00	.58	-

The final analysis utilises the same approach as above but explores the relationships between all of the variables within the MMYC.

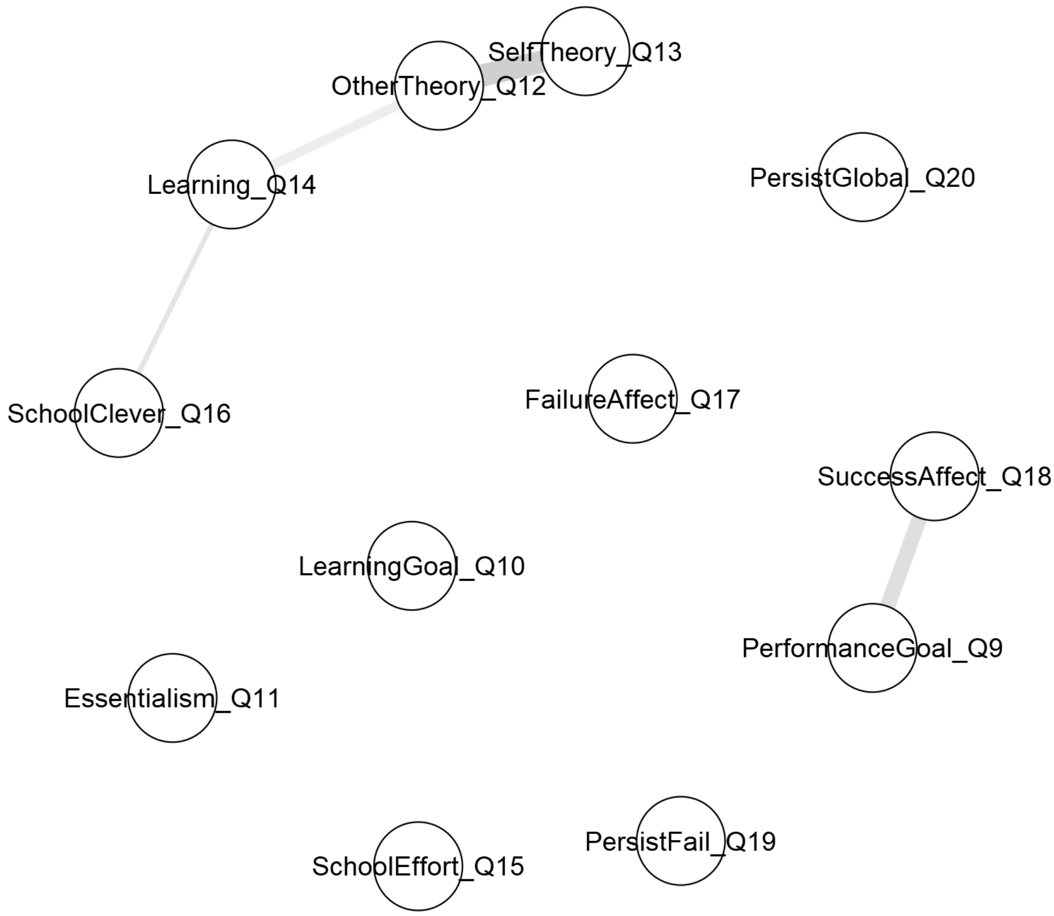

Figure 9. Network of constructs within the MMYC.

The results in Figure 9 and Table 7 show the relationship between Question 12 ("Can they change how clever they are?"), Question 13 ("Do you think that you can change how clever you are?"), and Question 14 ("If you learn something new does that make you more clever?") remains consistent in this model. This means that there are no additional variables to which they relate more strongly after including new variables into the network. However, this is a negative relationship between Question 16 ("Let's say you are doing well in school. Do you think this is because you are really clever?") and Question 14. The only other statistically meaningful relationship between variables was between Question 9 ("Let's pretend that the things to do in this picture are really easy, you will probably get them all right but you probably won't learn anything new. How would you feel about doing these?") and Question 18 ("If you got the chance to draw one of these again, how happy would you feel about drawing the house that you got right?")

Table 7.
Network analysis relationship weights.

		Q	1	2	3	4	5	6	7	8	9	10	11	12
1	Essentialism	11	-											
2	Failure – Affect	17	.00	-										
3	Performance goal	9	.00	.00	-									
4	Leaning goal	14	.00	.00	.00	-								
5	Mindset others	12	.00	.00	.00	.26	-							
6	Learning goal	10	.00	.00	.00	.00	.00	-						
7	Failure - Persistence	19	.00	.00	.00	.06	.00	.00	-					
8	Global persistence	20	.00	.00	.00	.00	.00	.00	.36	-				
9	School clever	16	.00	.00	.00	-.32	.00	.00	.00	.00	-			
10	School effort	15	.00	.00	.00	.00	.00	.00	.00	.00	.00	-		
11	Mindset self	13	.00	.00	.00	.00	.60	.00	.00	.00	.00	.00	-	
12	Success – affect	18	.00	.00	.40	.00	.00	.00	.00	.00	.00	.00	.00	-

2.4.4. Discussion

The results of this study demonstrate that the Dweck (2000) instrument performs as expected; the items all related together and had acceptable internal consistency statistics. Yet, results suggest that the constructs the MMYC investigates do not seem to relate as the literature suggests. For example, there was no statistically meaningful correlation between theory of intelligence, either Dweck (2000) or MMYC, and learning or performance goals. The findings of the EFA and network analysis further support this. This is in contrast to the SOMA model presented by Burnette et al., (2013) which suggests a clear path between implicit theory of intelligence and the associated behaviours as set out in the implicit theories framework (Dweck, 2000).

It could be that the single items used to measure the constructs as opposed to the usual multi-item Likert style approach could have resulted in poor measurement accuracy. As the items in the MMYC are a constellation of single items, it is not possible to explore any psychometric properties of them at the individual item level, save for the fact that there are no extreme responses and that hypothesised relationships exists between some variables. However, there is evidence that single-item instruments can be as accurate, if not more reliable, than multiple-item instruments (Bergkvist & Rossiter, 2007; DeSalvo et al., 2006; Wanous & Reichers, 1996). Considering such findings, it would seem unlikely that utilising single items would be problematic. Indeed, the items draw upon previously used approaches to measurement within this field, for example the use of imagined failure (e.g. Heyman et al., 1992; Kamins & Dweck, 1999; Skipper & Douglas, 2012). The items have strong face validity and were conceived by researchers who are expert in this area. Indeed, it has been argued that face validity is one of the most critical and often overlooked elements of scale development (Hardesty & Bearden, 2004). Therefore, it seems inappropriate to write-off the approaches to measurement taken in the MMYC.

A negative relationship was found between Question 14 and 16 which was unexpected. Question 14 asks "If you learn something new does this make you more clever?" and Question 16 asks "Let's say you are doing well in school. Do you think this is because you are really clever?". This negative relationship would suggest that participants understood 'doing well in school' to be different from 'learn something new'. This is a critical difference as the instrument is intended for use with younger pupils in schools. Considering how there are no statistically meaningful relationships between Question 15 ("Let's say you are doing well in school. Do you think that is because you are trying really hard?"), Question 16, and other constructs within the instrument, both items will be dropped to avoid the potential confusion.

In conclusion, the theory of intelligence items of the MMYC and Dweck's (2000) instrument correlate, which suggests that the MMYC is capturing participants' theory of intelligence effectively. However, the results also raise questions about how the different theoretical constructs relate to each other as put forward by Dweck (2000), Burnette et al. (2013), and Blackwell et al. (2007). Whilst there is a significant body of previous experimental evidence that suggests relationships between implicit theories and the other constructs; for example, learning goals (Tempelaar et al., 2015) and failure (Heine et al., 2005), however, the current evidence does not clearly support these links. Arguably there are many studies in support of the theoretical framework as a whole (e.g. Burnette et al., 2013; Molden & Dweck, 2006; Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018), considering such a large body of existing evidence it would be inappropriate to discount the framework because of the current single set of data. Therefore, as the current evidence suggests that the new instrument can successfully capture an individual's theory of intelligence it is worth further refining the instrument. However, it is also vitally important to extend this study and utilise existing instruments in parallel with each element of the MMYC to assess the item's ability to capture the construct under investigation.

2.5. Study 2

This Study follows on from the initial trialling with adults carried out in Study 1, which concluded that the MMYC was measuring the constructs under investigation. Some items were removed because of their potential to generate confusion. The resultant items making up the MMYC instrument needed to be trialled with pupils the same age as those taking part in the trial of the Stoke Reads Mindset Kit. This is the purpose of Study 2 - to see how young pupils engaged with the questions in the MMYC, and how user friendly the protocol was for test administrators without any training. Testing was completed over two time points; this was done to allow any revisions following the first trial to be tested in a subsequent trial and to measure test-retest reliability.

2.5.1. Method

2.5.1.1. Participants

Ethical approval was secured from the Keele University Ethical Review Panel. One primary school was recruited, located within the Stoke-on-Trent area via personal contacts. The Head Teacher was initially approached using a letter (see Appendix D), they then provided written consent via a consent form (see Appendix E). Parental consent for pupil participation was obtained by an opt-out method. Letters were sent home via pupils and parents were able to return a slip to school if they did not wish their child(ren) to participate (see Appendix F). This was compromised of one Reception class and one Year 1 class ($N = 51$; $M_{age} = 5.00$ years; $SD = 0.77$; range = 4 to 6 years of age; 21 females).

2.5.1.2. Materials

As previously mentioned, some elements of the instrument were removed as they were considered to be too complex for children. These were: "Let's say you are doing well in school. Do you think that is because you are trying really hard?", and "Let's say you are doing well in school. Do you think that this is because you are really clever?". The order of questions was refined following feedback from administrators after Time 0. For ease of reading the final order and numbering is adopted from this point on.

2.5.1.2.1. Practice responses

At their young age, it is possible that pupils may not have used a Likert response format before. Therefore, a set of practice items were provided. This required the administrator to present the smiley face response format (Figure 3) and read out

“I am going to show you some smiley and sad faces on a sheet of paper, you can use them to show me if you feel happy or sad about something, or how much you think something.”. Following this a relatable example was provided to participants to show them how to use it. Administrators then read the following “To show you how this works I am going to tell you about how I feel about different flavours of ice cream. I really like chocolate ice cream, so if someone asked me ‘How would you feel about eating chocolate ice cream?’ I would say ‘Really happy’”. A contrasting example is then provided, so that pupils may see how the response format provides an opportunity to express both positive and negative feelings towards a concept “Vanilla ice cream is a flavour that I really don’t like. If someone asked me ‘How do you feel about eating vanilla ice cream?’ I would say ‘Really sad’”. Finally, the pupil is provided with an opportunity to practice responding using the smiley face scale “Why don’t you have a go? If I gave you some strawberry ice cream now, how would you feel?”.

2.5.1.2.2. Questions 1 and 2 – Learning and Performance Goals

These questions are the same as described above

2.5.1.2.3. Question 3 through 6 – Reponses to Failure and Success

At Time 0 these questions were presented the same as described above. However, at Time 1 the global skill development question “How would you feel about practicing your drawing the next day?” was dropped as some pupils said that they would not like to practice drawing. This suggested that the global skill development element (as opposed to being focussed on the task) presented more of an activity preference question than persistence following failure. As the quantity of items had taken around five minutes per pupil to complete during Time 0 it was apparent that there was scope to maintain the quantity of items. Therefore, the question was replaced with one mirroring the affective response to failure question for success “How do you feel about your drawing of your house that you got right?”. This question was included based upon the argument put forward by Dweck, Chiu, and Hong (1995), that items which are constructed around a growth mindset proposition (e.g. “No matter how much intelligence you have, you can always change it quite a bit”) have a strong social desirability element. Therefore, pupils may respond to the question “If you got the chance to draw one of these again, how happy would you feel about drawing the cat that you got wrong?” not from their own preference but because they believe it what they are ‘supposed’ to do, i.e. as what would be expected in their classroom. This is particularly relevant for the experimental group in the trial of the Stoke Reads Mindset Kit as pupils would be in culture of growth mindsets. Therefore, the new item should allow pupils with a growth mindset who would feel sad (i.e. reject) the proposition of developing already ‘good’ work to respond accordingly. The difference between the two propositions will be explored in subsequent chapters.

The order of this section was also modified for clarity: Question 3 became “How do you feel about your drawing of the cat that you got wrong?”, Question 4 “If you got the chance to draw one of these again, how would you feel about drawing the cat that you got wrong last time?”, Question 5 “How do you feel about your drawing of the house that you got right?”, and Question 6 “If you got the chance to draw one of these again, how would you feel about drawing the house that you got right last time?”.

2.5.1.2.4. Question 7 - Aspiration

This is the same as described above

2.5.1.2.5. Question 8 through 10 – Theory of Intelligence

The order of questions remained the same: Question 8 “Are some people born clever?”, Question 9 “Can they change how clever they are?”, and Question 10 “Do you think that you can change how clever you are?”. There was limited statistically meaningful relationship between Question 8 and other items found in Study 1. However, the question was maintained because it logically precedes Question 9. Additionally, Haslam, Bastian, Bain, and Kashima (2006) have proposed links between essentialism (which Question 8 addresses) and implicit theories. The question which asked, “If you learn something new does that make you more clever?” was also dropped after Time 0 during this phase of trialling as part of an attempt to reduce the overall length of the instrument. In part this was because the remaining dichotomous questions had strong relationships both with each other and existing theory of intelligence measures.

2.5.1.3. Pre-testing procedure

Researchers were recruited from within the School of Psychology at Keele University to assist in test administration. A large team was required so that data collection would be completed in under one hour as this is all the time the school was willing to allocate to the process. In an attempt to provide a similar level of instruction as would be provided to teachers as part of the main research process, no briefing or training was provided surrounding the testing procedure. The instruction manual (see Appendix G) was provided two weeks prior to the first testing session and experimenters were encouraged to read this and the option to ask questions via e-mail was maintained. Appendix H is the final version of the MMYC. This mirrored the process which would be taken with teachers. The author received no questions from the research team during this time which suggested that the instruction manual provided sufficient instruction in how to administer the measures. Whilst it could be argued that colleagues within the School of Psychology would be familiar with psychometric testing instructions it would also be reasonable to assume that teachers and teaching assistants also have significant experience of test administration.

Prior to the initial testing session, the school was asked to create anonymous numbers for each pupil. This served two purposes, to maintain the anonymity of the pupils and allowed for data to be matched over the time points. These lists were organised by the class teachers and were not removed from site to protect anonymity.

2.5.1.4. Testing procedure

Testing was conducted in the school by a team of 10 experimenters, these were all individuals who had experience of working with children. Each experimenter was provided with printed copies of the instruction manual (in colour), testing materials and response sheets upon arrival at the school. Testing took place over one hour, during which each experimenter was assigned a group of pupils to conduct testing with. The assignment of pupils to administrator was changed between sessions to avoid any potential tester effects. During these sessions class teachers provided alternative activities for pupils when they were not taking part in testing. Testing took place in a spare classroom with experimenters being placed as far apart as possible. Experimenters collected pupils from the classroom and took them to the testing area. Pupils were informed that they were about to be asked some questions and that they didn't have to take part if they did not wish and could return to their classroom if they would prefer. Administrators then worked through the questions with pupils. Testing sessions were 1 week apart. A debrief was sent to parents via pupils after the testing was completed.

2.5.2. Results

Descriptive statistics for Likert-style response format questions are presented in Table 8 below. Descriptive statistics for dichotomous 'yes/no' questions are presented in Table 9 below. As these data are dichotomous only counts and percentage of responses are provided. Both Table 8 and Table 9 report the percentage of the responses which were the same from participants between time points. To explore whether this change is statistically meaningful, Kendall's *W* was performed. The first column presents the tau which indicates the strength of the relationship and the final column presents the Bayes Factor. Of these tests both Question 1 (performance goal) and Question 4 (persistence following failure) do not appear to be stable over time as the tau is low (.17 and -.07 respectively), both with a Bayes factor below 1, suggesting data provide negligible evidence in support of the relationship being statistically meaningful (Wagenmakers et al., 2018).

However, it is also advisable to consider multiple approaches to interpreting stability and reliability data (Vaz, Falkmer, Passmore, Parsons, & Andreou, 2013). Therefore, Bland and Altman plots (see Giavarina, 2015) are presented in Figure 10 and Figure 11. The distribution of differences between time points in both Question 1 and Question 4 are concentrated below and just above zero respectively. However, as can be seen in the plot for Question 1, the majority of difference scores are concentrated around zero. The differences between time points in Question 4 are more disperse. Overall, as most data fall within d-1.96s and d+1.96s (the upper and lower dashed line) this suggests that whilst responses may have differed between time points that this is within acceptable limits (Giavarina, 2015). In comparing the plots for Question 1 and 2 there is indeed greater difference between time points in Question 2 data. Yet these data have a stronger association as found by Kendall's W (tau = .17, BF = .76; tau = .39, BF = 235.33). Therefore, whilst data show variation between time points there is no major cause for concern.

As some items were dropped after Time 1 and new items were included at Time 2 it is necessary to report internal consistency coefficients for Time 1 and Time 2 separately. As previously discussed, Cronbach's alpha (α) is a poor measure of internal consistency (Bendermacher, 2010; Gjalt-Jorn Y Peters, 2014), therefore McDonald's Omega (ω) and the greatest lower bound will also be calculated. The secondary advantage to these coefficients is that they can accept the different response formats included in the MMYC. The items included at Time 1 were: performance goal (Q1), learning goal (Q2), affect following failure (Q3), persistence following failure (Q4), persistence following success (Q6), global skill development (Q20), entitativity (Q8), mindset – self (Q9), mindset – other (Q10), and learning develops intelligence (Q11). At Time 1 Cronbach's alpha (α) was .23, McDonald's omega (ω) was .40, and the greatest lower bound was .70. The items included at Time 2 were: performance goal (Q1), learning goal (Q2), affect following failure (Q3), persistence following failure (Q4), affect following success (Q5), persistence following success (Q6), entitativity (Q8), mindset – self (Q9), and mindset – other (Q10). At Time 2 Cronbach's alpha (α) was -.11, McDonald's omega (ω) was .16, and the greatest lower bound was .55. Both sets of reliability statistics could potentially cause concern, however, it is more appropriate to complete a structural analysis such as the network analysis completed in the previous study.

Histograms of data and distributions are presented in Figure 7 below. As can be seen from the histograms most items do not adhere to a Gaussian distribution, with items such as Question 6 (persistence following success) showing strong skew and kurtosis towards the lower response points. A majority suggest pupils have responded at the extreme ends of the scale with limited responses in the middle of the distribution. However, such a response pattern is not unexpected from younger children and should not mean that data or instrument are discounted, more that it is a feature of them and needs to be recognised as part of the interpretation process (Chambers & Johnston, 2002). Finally, whilst data are clearly not normal, this is not a concern as data will be analysed within the Bayesian framework (Kruschke, 2015).

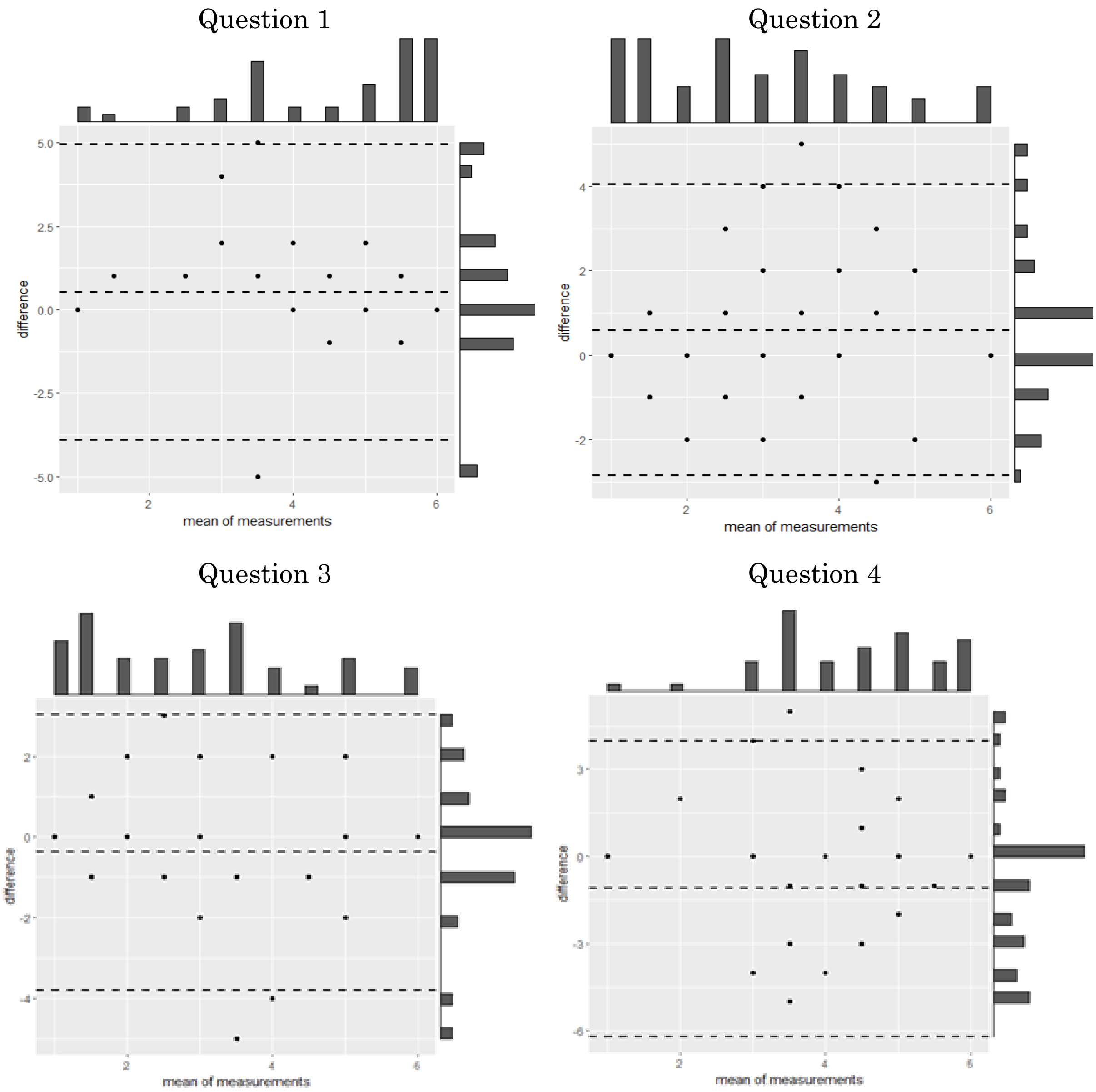

Figure 10. Bland-Altman plots for Questions 1 through 4.

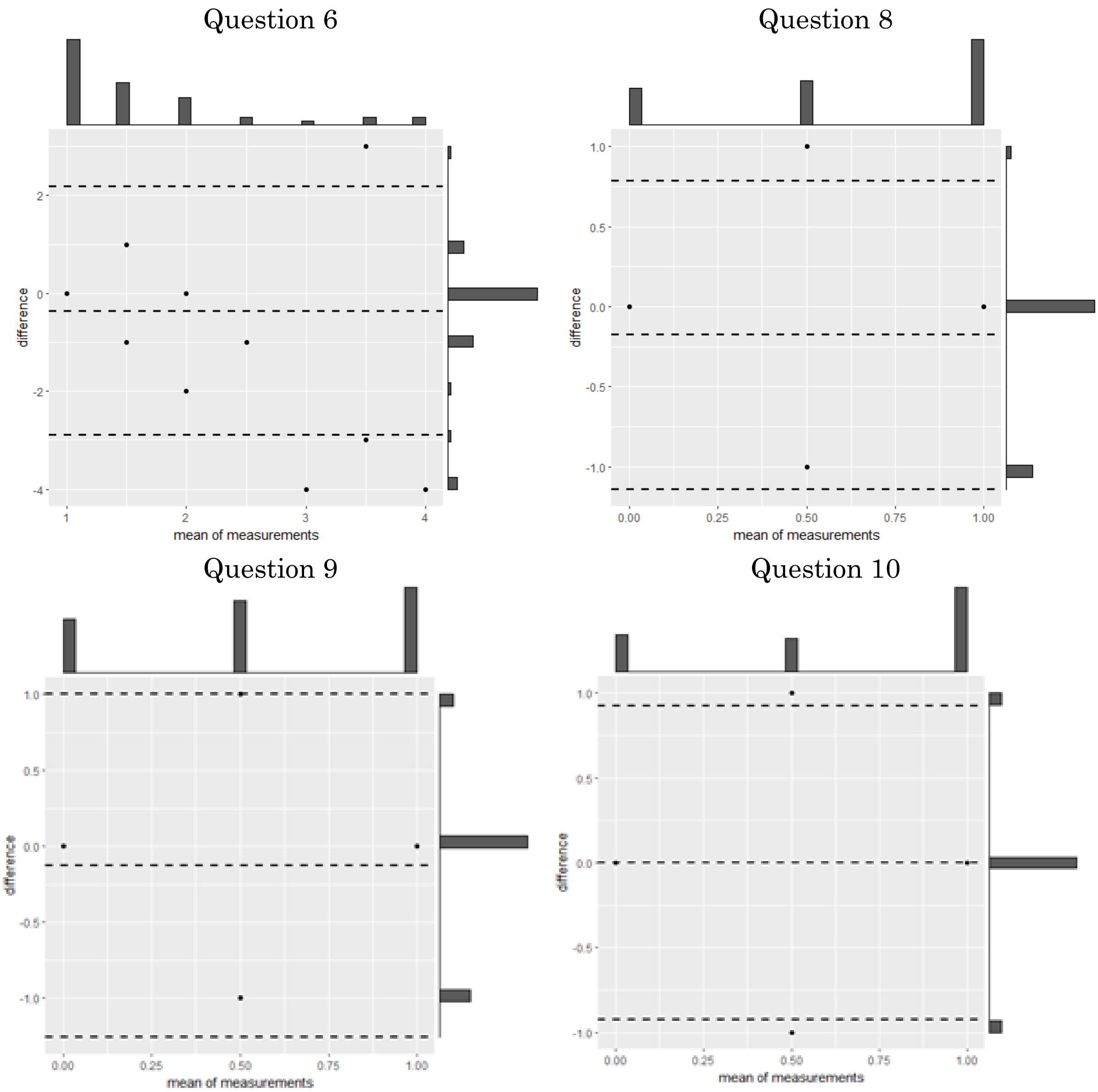

Figure 11. Bland-Altman plots for Questions 6 through 10.

Table 8.
Descriptive statistics for 'smiley face' response format questions.

Measure	Q	Time	Mean	SD	L95% CI	U95% CI	Response T0-T1 (%)	Kendall's *W* tau	Kendall's *W* BF_{10}
Performance Goal	1	0	3.08	1.74	2.60	3.56	31.91	.17	.76
		1	2.64	1.66	2.16	3.11			
Learning Goal	2	0	4.73	1.66	4.27	5.18	30.43	.39	235.33
		1	4.29	1.98	3.73	4.85			
Failure - Affect	3	0	2.69	1.52	2.27	3.10	34.04	.40	452.80
		1	3.06	1.85	2.54	3.59			
Failure - Persistence	4	0	3.80	1.83	3.28	4.31	32.61	-.07	.24
		1	4.81	1.68	4.34	5.29			
Success - Affect	5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		1	1.27	0.82	1.04	1.50			
Success - Persistence	6	0	1.42	0.70	1.23	1.61	59.57	.47	770.53
		1	1.88	1.42	1.47	2.28			
Persistence – Global skill	20	0	1.94	1.41	1.55	2.33	N/A	N/A	N/A
		1	N/A	N/A	N/A	N/A			

Table 9.
Descriptive statistics for dichotomous 'yes/no' questions.

Measure	Q	Time	Count 'yes'	Percentage 'yes' (%)	Response T0-T1 (%)	Kendall's *W* tau	Kendall's *W* BF_{10}
Are some people born clever?	8	0	43.14	22.00	73.33	.47	5021.72
		1	27.08	13.00			
Can they change how clever they are?	9	0	52.94	27.00	65.96	.33	30.93
		1	62.50	30.00			
Do you think you can change how clever you are?	10	0	66.67	34.00	78.26	.52	61173.15
		1	64.58	31.00			
If you learn something new does that make you more clever?	11	0	88.24	45.00	N/A	N/A	N/A
		1	N/A	N/A			

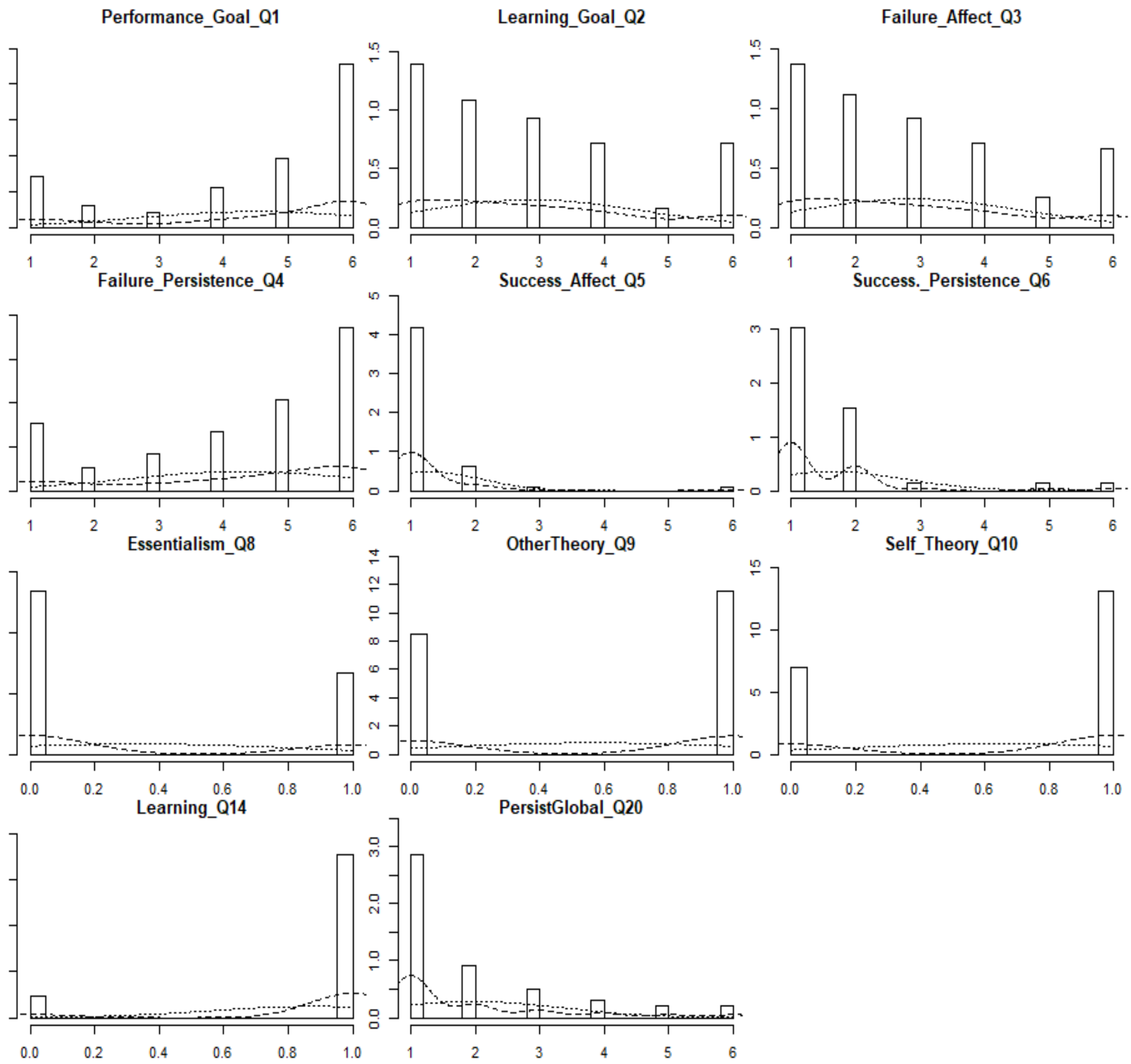

Figure 12. Histogram of all variables, time points collapsed. Dotted line = normal distribution. Dashed line = density.

To explore the relationships between items a correlation matrix was produced (see Table 10). Testing was only one week apart, therefore, the two time points were collapsed in the initial instance. The most striking result was the lack of association between items. Interestingly, there is a negative relationship (r=- 33, BF = 23.74) between learning goals (Q2) and affective response to failure (Q3). The Bayes factor of 23.74 suggests that there is a 'strong' level of evidence towards the relationship being meaningful (Wagenmakers et al., 2018). There is also a positive relationship ($r = .32$, $BF = 21.61$) between theory of intelligence for the self and others (Q9 & 10). This Bayes factor also falls into the 'strong' evidence category. Such evidence suggests that once again there are limited relationships between the items in the MMYC. However, there are some relationships evident as prescribed by the implicit theories framework. Therefore, this suggests that a similar pattern as was found in the previous study that there are limited associations between the tenets of the implicit theories framework.

Table 10.

Correlations between all variables, time points collapsed.

		Q	1	2	3	4	5	6	7	8	9	10	11
1	Performance Goal	1	—										
2	Leaning Goal	2	.21	—									
3	Failure - affect	3	.21	-.33 *	—								
4	Failure - persistence	4	-.05	-.14	.17	—							
5	Success - affect	5	-.08	.07	-.11	-.30	—						
6	Success - persistence	6	-.16	.13	-.14	.11	.08	—					
7	Essentialism	8	-.04	-.06	.17	.02	.10	.02	—				
8	Mindset others	9	-.05	.19	-.03	-.05	.05	.13	.13	—			
9	Mindset self	10	.08	.16	<.01	-.03	-.12	.17	-.09	.32 *	—		
10	Learning increase	14	.01	.02	.05	.15	N/A	.05	.01	.02	-.13	—	
11	Global persistence	20	-.16	.09	-.04	.23	N/A	-.04	.03	.05	-.16	-.02	—

* $BF_{10} > 10$, ** $BF_{10} > 30$, *** $BF_{10} > 100$

Table 11.
Principal axis factoring obliquely rotated component loadings.

	Q	Time 0	Time 1
Performance goal	1	.31	.33
Learning goal	2	.64	-.39
Failure – affect	3	-.04	1.00
Failure – persistence	4	-.18	.16
Success – persistence	6	.26	-.30
Essentialism	8	-.10	.14
Mindset others	9	.46	-.22
Mindset self	10	.70	-.07

To begin further investigation of the relationship between items Principal Axis Factoring (PAF) was used, loadings are presented in Table 11. Only items from the final version were included: Questions 1, 2, 3, 4, 6, 8, 9, and 10. As set out above, there was variation in responses from pupils between time points this procedure was completed separately for both time points in the data. The results of PAF (oblique rotation) on Time 0 data did not suggest that the items loaded satisfactorily onto one factor as the loadings were not stable (range = -.10 to .70) and explained 17% of variance. However, what is interesting that when using the 'significant loading' criteria of .30 or higher (Kline, 2002) then learning and performance goals and both mindset items (Questions 1, 2, 9, and 10) seemed to be related. Time 1 results are even less supportive of a single factor as the model was unable to converge (as Question 3 loading = 1.00) and explaining 18% of data. To allow data to coalesce around patterns within data rather than force them into a single factor, Exploratory Factor Analysis was used, and items were statistically selected based upon Eigenvalues. This was set to the Kaiser criterion (i.e. Eigenvalues equal to or greater than 1) (Yeomans & Golder, 1982). Oblique rotation was implemented.

Table 12.
Exploratory factor analysis loadings

		Time 0		Time 1	
	Q	Loading	Uniqueness	Loading	Uniqueness
Performance goal	1	.31	.90	.33	.89
Learning goal	2	.64	.59	-.39	.85
Failure – affect	3	-.04	.99	1.00	<-.01
Failure – persistence	4	-.18	.97	.16	.97
Success – persistence	6	.26	.94	-.30	.91
Essentialism	8	-.10	.99	.14	.98
Mindset others	9	.46	.79	-.22	.95
Mindset self	10	.70	.50	-.07	.99

The Time 1 results (see Table 12) which used a 'significant loading' criteria of .30 or above (Kline, 2002) found a similar pattern to that of the principal axis factoring, that Questions 1, 2, 9, and 10 form a meaningful factor (χ^2 (20) = 18.09, p = .582), Arguably, Question 6 was not too far away from inclusion in this. However, as above, Time 1 data (see Table 12) were dominated by Question 3 (affective response to failure). It was unclear why this is the case as responses to Question 3 were stable over time ($M_{\text{Time 0}}$ = 2.69, $M_{\text{Time 1}}$ = 3.06, Kendall's *W* = .40, BF = 452.80). Yet, the model provided an adequate fit to data (χ^2 (20) = 23.91, p = .246), but the model is theoretically and practically implausible and should be discounted. Time 0 data suggested loadings which would be expected – a relationship between theory of intelligence and achievement goals. With response to failure being very close to being part of this factor. However, the model at Time 1 suggested that Question 3 loaded perfectly (loading of 1.00) along with Question 1 (.33) to one factor. But, Question 2 and 5 loaded on another factor, with Question 9 and 10 being in the same direction. To further explore the relationships between items and potentially uncover any paths or mediated relationships a network analysis was employed.

As discovered in the above factor analyses data were sufficiently different between Time 1 and Time 2, which suggested that it was inappropriate to collapse the time points and they were therefore separated out. The same style of network analysis implement in the previous study was then used to explore how the different constructs related to each other. In the current analysis partial correlation and adaptive LASSO regularisation were used as data are not continuous (Epskamp et al., 2017; Epskamp & Fried, 2016).

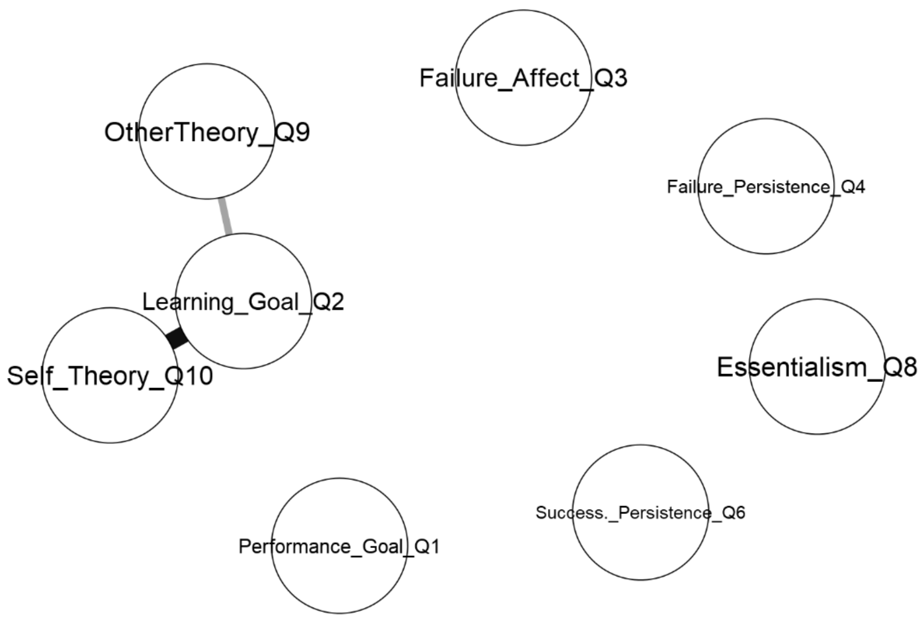

Figure 13. Network analysis – Time 0.

Table 13.
Network analysis weights – Time 0.

		Q	1	2	3	4	5	6	7	8
1	Essentialism	8	-							
2	Failure - affect	3	.00	-						
3	Failure - persistence	4	.00	.00	-					
4	Learning goal	2	.00	.00	.00	-				
5	Mindset other	9	.00	.00	.00	.12	-			
6	Performance goal	1	.00	.00	.00	.00	.00	-		
7	Mindset self	10	.00	.00	.00	.33	.00	.00	-	
8	Success - persistence	6	.00	.00	.00	.00	.00	.00	.00	-

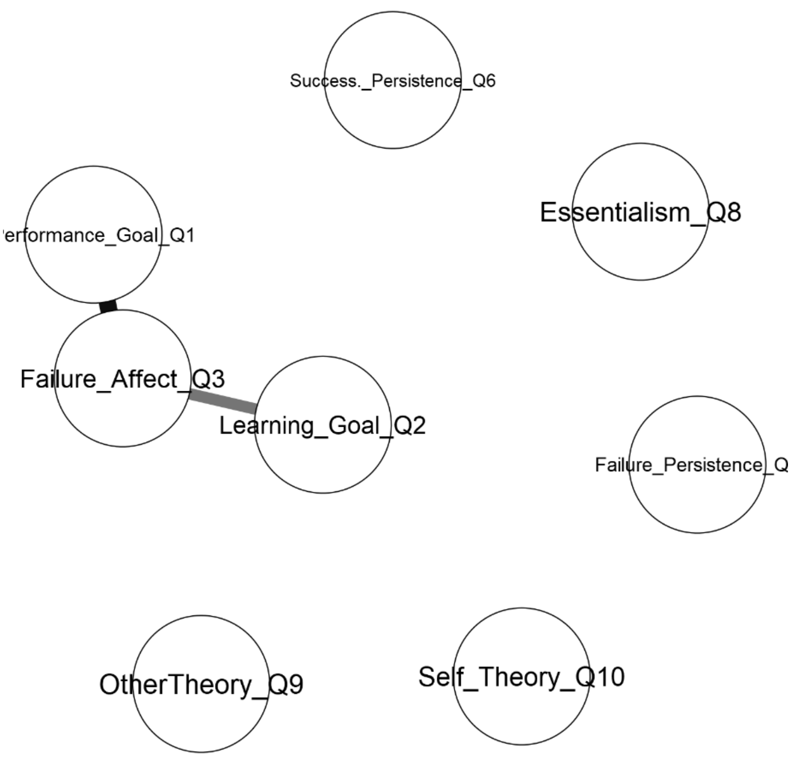

Figure 14. Network analysis – Time 1.

Table 14.
Network analysis weights - Time 1.

	Variable	Q	1	2	3	4	5	6	7	8	9
1	Essentialism	8	-								
2	Failure Affect	3	.00	-							
3	Failure persistence	4	.00	.00	-						
4	Learning goal	2	.00	.16	.00	-					
5	Mindset other	9	.00	.00	.00	.00	-				
6	Performance goal	1	.00	.34	.00	.00	.00	-			
7	Mindset self	10	.00	.00	.00	.00	.00	.00	-		
8	Success persistence	6	.00	.00	.00	.00	.00	.00	.00	-	
9	Success affect	5	.00	.00	.00	.00	.00	.00	.00	.00	-

The network analyses at Time 1 demonstrated some relationships that would be predicted by theory, for example a strong connection between implicit theory and learning goals. However, there was no relationship with performance goal, which would be expected conceptually, as this item is the opposite of learning goals an inverted relationship would be predicted. Additionally, there was no relationship between implicit theory and response to failure, another key tenet of the theoretical framework. Further contrary to theory, a negative relationship between learning goals and affective response to failure was found in the Time 1 data. As items were coded in the same direction (i.e. they should all have positive relationships), this suggests that those with a learning goal would have more negative affect following a failure.

2.5.3. Discussion

Similar to the findings reported above, it appeared that the constructs traditionally associated within the framework did not appear to link together as theorised. This may be because, as suggested by Bempechat et al. (1991) young children may hold distinct patterns of mindsets in relation to social domains but that intelligence mindsets may not fully crystallise until later in their development. However, other evidence is contrary to this finding and shows clear relations between theories of intelligence and behaviours as prescribed by the framework. For example, children as young as three years of age are more likely to cheat following person praise (i.e. have been primed to have a fixed mindset) than those who received process praise (i.e. have been primed to have a growth mindset) (Zhao et al., 2017). There is of course the potential that the MMYC has failed to capture the different behaviours and cognitions associated with mindsets. Therefore, the next step was to assess the different items in the framework using existing instruments (designed for adults) and the MMYC in an adult population. This will allow for two questions to be addressed: firstly, do MMYC items have convergent validity with existing instruments, or in other words – is the MMYC a useful measure? Secondly, expected relationships between MMYC items (e.g. implicit theories and learning goals) were not found. This raises the possibility that when measured with the MMYC the framework does not hold, or it could be that it is not possible to replicate data that support the framework, or children do not have fully formed mindsets. By sampling adults and using existing instruments a replication of Blackwell et al. (2007) will allow both questions to be addressed.

It is possible that the one-week gap between test administrations was insufficient for pupils' memories of the testing to have a faded which resulted in the differences in responses between time points. Lay logic or common sense would suggest that a shorter interval between test administrations would result in more stable responses from participants, in other words – pupils would not have had chance to change their minds. However, some researchers suggest that there should be enough time between test administrations so subjects would not be likely to remember or be influenced by their first set of responses (Robson & McCartan, 2015). Arguably, one week is too small to allow memories to fade, as evidence suggests that children of this age can remember events from the previous week and have also been found to recall unusual events, such as a team of researchers coming into school more vividly (Schneider & Ornstein, 2015). Additionally, the team of external adults visiting the school twice with a short delay, may have led to an increase in social desirability bias in the sample as pupils become more familiar with the research activity taking place in school and wishing to 'perform well' and create a 'good impression' (Krumpal, 2013). Indeed, the Hawthorne effect suggests that the very act of asking pupils to reflect on their mindset during the administration of the instrument is sufficient stimuli to produce an effect (McCarney et al., 2007). These issues are potentially further compounded by the evidence which suggests that even subtle linguistic manipulations can influence young children's mindsets, highlighting the sensitivity of mindsets (Cimpian et al., 2007; Zhao et al., 2017). Therefore, as mindsets have been shown to be so malleable and that the pupils in the current study have been influenced by the very act of adults external to the school asking them to reflect on topics associated with mindsets, it is possible that this contributed to changes in their mindsets.

A key element of the current study was an assessment of the practicalities of test administration and whether researchers concluded that the pupils comprehended the questions. This involved recruiting administrators and assessing whether the materials that form the MMYC (see Appendix F) provided enough instruction and were sufficiently accessible. A mixture of academics, a literacy specialist, undergraduate and masters student volunteers conducted the test administration. They were all sent the materials of the MMYC via e-mail which stated that they could ask any questions should they have them. This was the same process as would be used in the main study. No questions were received in relation to the administration process, and the researcher who observed administration found the test to be satisfactorily administered by the range of individuals in the research team. Whilst the argument could be made that the team were more experienced in test administration, this is balanced by the familiarity that educators have with the myriad testing formats that they carry out as part of their practice in the UK (Sanderse, Walker, & Jones, 2015). In respect of the instruments ability to measure the psychological constructs under investigation, there is some suggestion from data that this it is performing adequately. However, as the data from both this study and Study 1 suggests, the mindset framework as put forward in the extant literature may not be as described.

2.6. Study 3

The results of the previous two studies could lead to two conclusions: the MMYC was failing to accurately measure the desired constructs, or that the theoretical framework did not hold as prescribed by the literature. Therefore, to understand which of these was correct, it was necessary to complete a conceptual replication of previous studies that have set out the relationships between the constructs of the implicit theories framework (Blackwell et al, 2007; Burnette et al., 2013; Dinger & Dichauser, 2016; Dupeyrat & Maurine, 2005). A conceptual replication is one which focusses on the theoretical constructs and relationships or predictions prescribed within a given framework. Frequently they utilise different methods or instruments to investigate whether the original findings were contingent upon the original methodology (Hüffmeier, Mazei, & Schultze, 2016). In the current study the MMYC was administered to a sample of adults alongside extant instruments for all of the constructs from the framework put forward by Blackwell et al. (2007). The only change to the MMYC was the inclusion of hand-drawn pictures for the response to failure and success questions. This was done to try and make the scenario as realistic as possible for pupils. It is more likely that pupils would imagine themselves completing drawings that looked like ones they would potentially create and therefore, have a more meaningful response to the question.

There have been several attempts to explore if, and how, implicit theories of intelligence may be antecedents of their associated behaviours. Several of these have focussed on the relationship between implicit theories and achievement goals. An early attempt at exploring these relationships was by Dupeyrat and

Mariné (2005); their hypothesised model is set out on the left in Figure 19 below with the resultant path model on the right. There are a few key features of the path model (right): that there is no relationship between incremental theory of intelligence and mastery goals and entity theories do not predict performance goals which are not ultimately related to achievement. This is contrary to suggestions by Dweck and colleagues in the literature (e.g. Elliott & Dweck, 1988; Grant & Dweck, 2003). Dinger and Dickhäuser (2013) explored if implicit theory of intelligence causes achievement goals by experimentally manipulating university students' theory of intelligence. They found that incremental theories of intelligence predicted mastery goals, however, neither incremental nor entity theory of intelligence predicted performance goals. This lack of relationship between entity theory and performance goals supports Dupeyrat and Mariné (2005), however, their finding that incremental theories directly predict mastery goals did not mirror Dupeyrat and Mariné (2005) (see Figure 19, right panel). Dickhäuser, Dinger, Janke, Spinath, and Steinmayr (2016) extended their initial work and found that an incremental theory of intelligence predicted mastery goals but had no association with performance goals. Additionally, mastery goals were not directly predictive of achievement which fed in to 'intrinsic motivation', which captured student's perceived value of their school work (e.g. "The things that I learn in school are interesting to me"), which in turn predicted academic achievement. All three of these studies demonstrate the contrary findings within the literature about the relationships between constructs in the self-theories framework, even with the sub-domain of achievement goals.

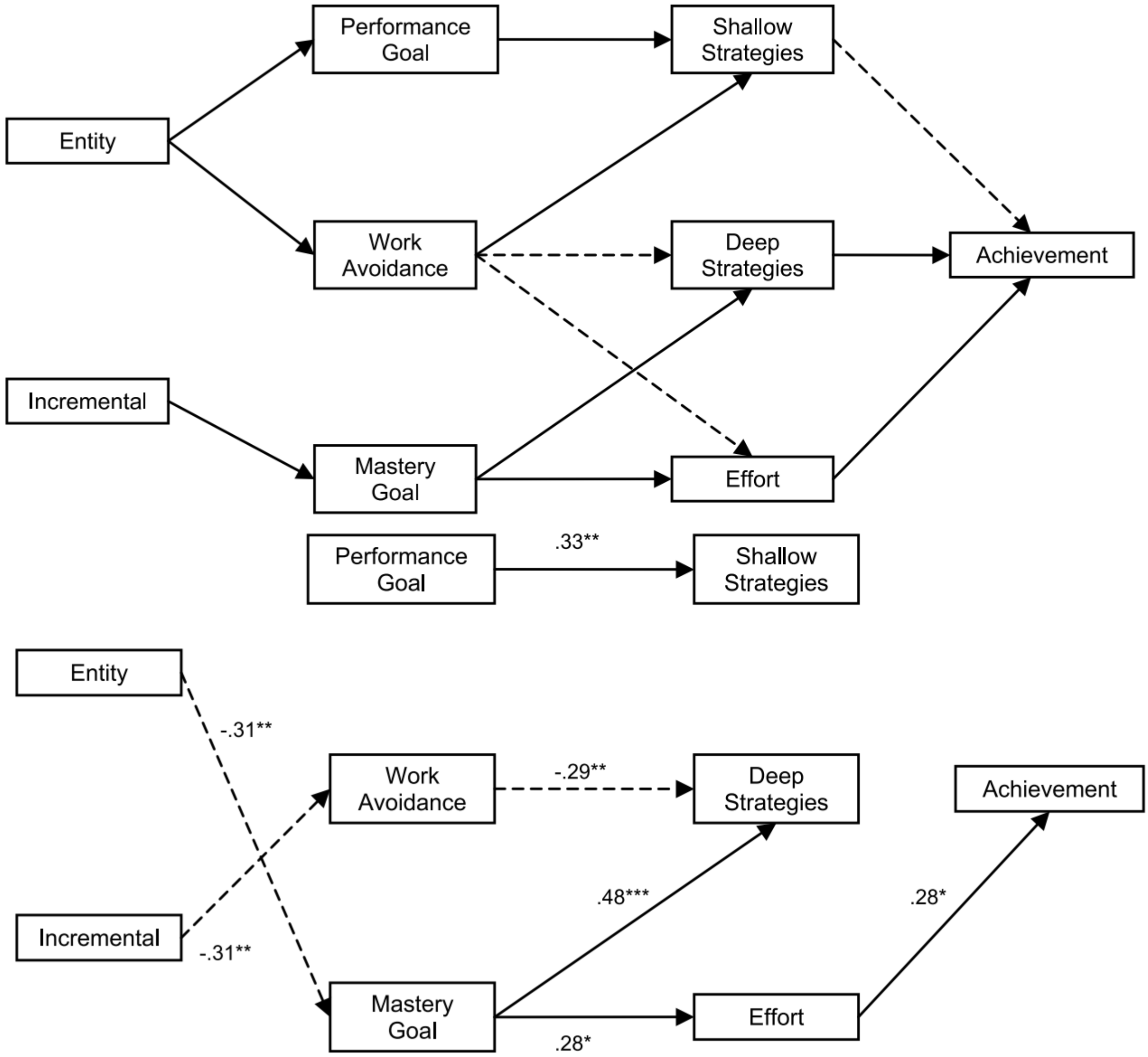

Figure 15. Hypothesised model (top) and resultant path model (bottom). Reprinted from “Implicit theories of intelligence, goal orientation, cognitive engagement, and achievement: A test of Dweck's model with returning to school adults” by Dupeyrat, C. and Mariné, C. (2005).

The decision to replicate the Blackwell et al. (2007) model as opposed to the Burnette et al.'s (2013) SOMA model, or the models put forward by Dupeyrat and Mariné (2005) or Dickhäuser et al. (2016) was taken because the constructs which are within Blackwell et al.’s (2007) model are constructs which have a substantial body of evidence linking them to a growth mindset and are part of the self-theories framework (see Dweck, 2000). Arguably, the Blackwell et al. (2007) model does not feature some of the more contemporary additions to the theory. However, these features do not have as substantial an evidence base and a detailed exploration of the theoretical framework is not the focus of the current research. The SOMA model has both approach/avoidance as mediating factor of performance/learning goals and ego threat as a mediator of all components of a growth mindset, Dupeyrat and Mariné (2005) included shallow and deep learning strategies. Simply, such expansions of the nomological network, whilst theoretically justifiable, would draw the current study away from its primary motivation of investigating whether the MMYC is an effective measure of mindsets. Finally, as Burnette et al. (2013) utilised meta-analysis, they draw upon studies from varied fields (e.g management, health, and technology), ages (e.g. early years through to adulthood), and cultures (e.g. Australia, Hong Kong, and United States). Compared to the context of the current research this means it is unlikely to be a useful replication as the varied adult sample populations they utilised, both in respect of cultures but also mindsets in domains other than intelligence or education, would be too dissimilar from the participants in this thesis which the MMYC is intended for use with. However, this variety of sample and studies provides a robust model on which to draw comparisons between their findings, current data, and Blackwell et al. (2007).

This study aimed to address several questions. Firstly, if the MMYC is a useful instrument to capture mindsets. This will be addressed by examining the convergent validity between MMYC items and existing instruments. Secondly, this study will explore the self-theories framework as the previous two studies did not support many of the relationships between constructs as suggested by previous research. This exploration will be primarily based around a conceptual replication of the model put forward by Blackwell et al. (2007).

2.6.1. Method

2.6.1.1. Participants

Ethical approval was granted by Keele University (see Appendix I). Participants were undergraduate students recruited in exchange for course credits (N = 125; M_{age} = 19.18 years; SD = 2.44; range = 18 to 40 years of age; 76% females; 22.4% males; 0.8% transgender; 0.8% preferred not to state the gender to which they identify).

2.6.1.2. Materials

The items and numbering of the MMYC presented in the previous study are the final version and will remain the same in this study.

2.6.1.2.1. Question 1 and 2 – Learning and Performance Goals.

These are the learning and performance goal questions as described above.

2.6.1.2.2. Question 3 through 6 – Responses to failure and success.

The format of these questions was maintained; however, the drawings were updated, and hand drawn in the style which a child the same age as the target participants would be in the current research (see Figure 15).

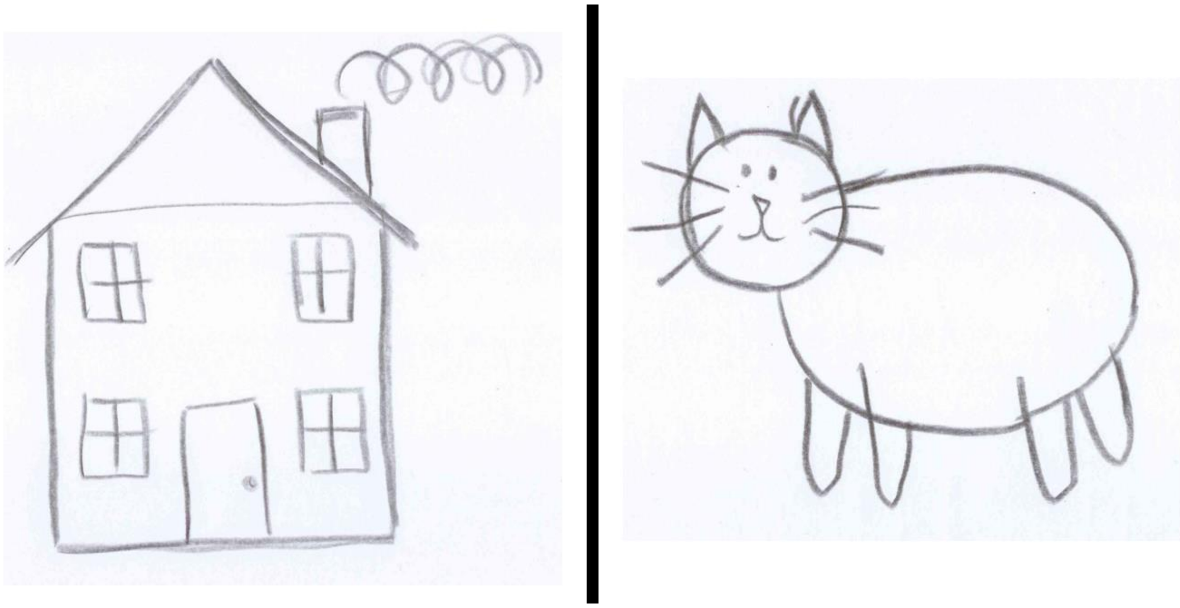

Figure 16. Updated 'correct' house and 'incorrect' cat drawings.

2.6.1.2.3. Question 7– Aspiration

This is the aspiration question as described above.

2.6.1.2.4. Question 8 through 10 – Theory of Intelligence.

The materials and format of these questions was maintained (yes/no) and the first three questions were maintained: Question 8 - "Are some people born clever?", Question 9 - "Can they change how clever they are?", and Question 10 - "Do you think that you can change how clever you are?".

2.6.1.2.5. Question 11 through 16 - Theory of intelligence.

These questions were taken from the Implicit Theory of Intelligence Scale from Dweck (2000). As the name suggests, this instrument is designed to measure an implicit theory of intelligence. It contains the following items:

11. "You have a certain amount of intelligence, and you can't really do much to change it"

12. “No matter how much intelligence you have, you can always change it quite a bit”
13. “Your intelligence is something about you that you can't change very much”
14. “You can learn new things, but you can't really change your basic intelligence”
15. “No matter who you are, you can change your intelligence a lot”
16. “You can always greatly change how intelligent you are”

To which participants respond using Likert-style response format (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Mostly disagree). Questions 12, 15, and 16 were reverse coded so that higher score denoted a growth mindset.

2.6.1.2.6. Question 17 through 19 – Outcome or Performance Goals. Replicating the Blackwell et al. (2007) study is not without its own challenges. As suggested by Grant and Dweck (2003) learning and performance goals may need extending to include challenge-mastery and ability goals. The difference between these constructs is potentially subtle, in that performance goals is a desire to ‘do well’ (e.g. “It is very important to me to do well in my classes”), learning goals is a desire to learn (e.g. “I strive to constantly learn and improve in my courses”). Yet ability goals are a desire to demonstrate intelligence through school work (e.g. “It is important to me to confirm my intelligence through my schoolwork”), and challenge-mastery goals operationalises a drive towards challenges (e.g. “I see out courses that I will find challenging”). Blackwell et al. (2007) utilised the Task

Goal Orientation subscale from Midgley et al., (1998) which is based upon six items:

1. "I like school work that I'll learn from, even if I make a lot of mistakes"
2. "An important reason why I do my school work is because I like to learn new things"
3. "I like school work best when it really makes me think"
4. "An important reason why I do my work in school is because I want to get better at it"
5. "I do my school work because I'm interested in it"
6. "An important reason I do my school work is because I enjoy it"

These items are conceptually very similar to the items described above from Grant and Dweck (2003). However, taken collectively the items seem to describe two, if not three separate constructs. Firstly, Question 5 presents several challenges, it addresses whether the pupil is interested in the work they are completing and furthermore, is not subject specific. Previous research has shown that whether a pupil has a direct interest in the subject influences both their engagement in specific lessons and overall achievement in the subject (Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). Secondly, Question 6 focusses on pupils' enjoyment of their school work. Indeed, enjoyment has been linked to motivation, however as a distinct construct rather than a direct element of motivation (Gottfried, 1990; Retelsdorf, Köller, & Möller, 2011). It is logical that a pupil who enjoys or is interested in their work would demonstrate task goal orientations. However, these two elements do not feature in the constructs described in the growth mindset literature (Elliot & Dweck, 2005; Grant &

Dweck, 2003). Therefore, to provide a wider range of learning and performance goal orientation the Grant and Dweck (2003) instruments covering learning goals, performance goals, ability goals, and challenge-mastery goals will be used instead. Additionally, Question 5 and 6 aside, there are items which with strong convergent validity to those in the Midgely et al. (1998) Pattern of Adaptive Learning Scale. Finally, the goal of this study is a conceptual replication and using other instruments may provide both greater accuracy and theoretical detail.

This three-item instrument was taken from Grant and Dweck (2003). It captures outcome or performance goals in the school context, and contains the following three items:

17. "It is very important to me to do well in my classes"
18. "I really want to get good grades in my classes"
19. "A major goal I have in my courses is to perform really well"

Participants respond on a 7-point response scale (1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Unsure, 5 = Slightly agree, 6 = Agree, 7 = Strongly Agree). These were reverse coded so that a higher score denoted a growth mindset.

2.6.1.2.7. Question 20 through 22 – Performance goals.

This three-item instrument was taken from Grant and Dweck (2003). The instrument captures an individual's desire to demonstrate their intelligence through scholastic aptitude, containing the following three items:

20. "It is important to me to confirm my intelligence through my schoolwork"

21. “In school I am focused on demonstrating my intellectual ability”
22. “One of my important goals is to validate my intelligence through school work”

Participants responded on a 7-point response scale (1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Unsure, 5 = Slightly agree, 6 = Agree, 7 = Strongly Agree). These were reverse coded so that a higher score denoted a growth mindset.

2.6.1.2.8. Question 23 through 25– Learning goals.

This three-item instrument was taken from Grant and Dweck (2003). These items are designed to assess whether individual’s pursue opportunities to acquire new skills and knowledge during their education, this has three items:

23. “I strive to constantly learn and improve in my courses”
24. “In school I am always seeking opportunities to develop new skills and acquire new knowledge”
25. “In my classes I focus on developing my abilities and acquiring new ones”

Participants respond on a 7-point response scale (1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Unsure, 5 = Slightly agree, 6 = Agree, 7 = Strongly Agree).

2.6.1.2.9. Question 26 through 28 – Challenge-mastery goals.

This three-item instrument was taken from Grant and Dweck (2003). To investigate participants enjoyment of challenges within their schooling this instrument asks the following three questions:

26. “I seek out courses that I will find challenging”
27. “I really enjoy facing challenges, and I seek out opportunities to do so in my courses”
28. “It is very important to me to feel that my coursework offers me real challenges”

Participants respond on a 7-point response scale (1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Unsure, 5 = Slightly agree, 6 = Agree, 7 = Strongly Agree).

2.6.1.2.10. Question 29 through 32 – Response to failure (helpless attributions).

This instrument was taken from Blackwell et al. (2007) and utilised a short vignette designed to provide participants with a sense of failure:

"You start a new class at the beginning of the year and you really like the subject and the teacher. You think you know the subject pretty well, so you study a medium amount for the first quiz. Afterwards, you think you did okay, even though there were some questions you didn't know the answer for. Then the class gets their quizzes back and you find out your score: you only got a 54, and that's an F."

This is followed by four questions which assess whether participants asked to rate how much their ability or other factors caused the failure. Participants rated their agreement or disagreement using a 6-point scale (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Strongly disagree) on the following four statements:

29. “I wasn't smart enough”

30. “I'm just not good at this subject”

31. “The test was unfair”

32. “I didn't really like the subject”

2.6.1.2.11. Question 33 through 35 – Response to failure (positive strategies).

This instrument is the second part of the Blackwell et al. (2007) instrument and follows on from the vignette outlined above. Again, participants rated their agreement or disagreement using a 6-point scale (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Strongly disagree).

The second asks participants about negative effort-avoidant strategies with following three items:

33. “I would try not to take this subject ever again”

34. “I would spend less time on this subject from now on”

35. “I would try to cheat on the next test”

2.6.1.2.12. Question 36 and 37 – Effort beliefs.

As discussed, Blackwell et al. (2007) does not report in detail the items for all instruments which were used in Study 1. For some elements this is not problematic as it was possible to locate the original materials (i.e. Midgeley et al., 1998; Dweck, 2000). They provide a complete description of the four ‘helpless attributions’ and the five ‘positive strategies’ items which correspond to the number of indicators which comprise the latent variables in their model (see Figure 2 above). However, for the ‘effort beliefs’ items used were from Blackwell’s

(2002) unpublished doctoral thesis. It provides the quantity of items included in the model (nine) and an example item from the three domains the scale measures (effort leads to positive outcomes, effort is negatively related to ability, and effort is ineffective in achieving positive outcome) but a complete list of the items used is not available. Unfortunately, it was not possible to locate the instrument in full as it is unpublished, even in other work by other researchers which utilise the instrument. The body text of the article reports that the nine items were merged to produce the scale with four being shown as latent variable indicators in their path model (see Figure 2). However, the three domains which the measure covers are arguably both conceptually similar. The positive effort items (e.g. "The harder you work at something, the better you will be at it") is the inverse of items capturing a view that effort is ineffective in achieving positive outcomes (e.g. "If you're not good at a subject, working hard won't make you good at it"). The items relating to a view that effort is negatively related to ability are conceptually different to these items (e.g. "To tell the truth, when I work hard at my schoolwork, it makes me feel like I'm not very smart"). The example item they provide describes a more affective response to the application of effort to a challenge as opposed to the other two concepts that capture the individual's view of the utility of effort in overcoming challenges. As the description and reporting of the quantity of items between the model and materials section is contradictory, and there is a potential conceptual difference within the items this instrument will not be used.

As this is a conceptual and not a direct replication, the current study will not capture educational performance data as the ultimate outcome variable.

Therefore, the final psychological variable will be 'positive strategies'. It is within this subset of items that there are potential replacements for positive effort beliefs. As Blackwell et al. (2007) list, the items are either positive or negative effort based (e.g. "I would work harder on this test from now on" or "I would try to cheat on the next test"). Conceptually only the negative items relate to strategies, as the positive items discuss effort, the two items are the previous example and "I would spend more time studying for tests". Logically, investigating views surrounding the application of effort following a failure is arguably presents a more robust measure of effort, as an individual would not apply effort following a failure if they did not believe that it would have beneficial consequences. Therefore, the two positive effort-based items will be used in place of the effort beliefs items.

This instrument was taken from Blackwell et al. (2007) and participants rated their agreement or disagreement using a 6-point scale (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Strongly disagree). The two items were reverse coded so when all items were combined a higher score denoted a growth mindset:

36. "I would work harder in this class from now on"
37. "I would spend more time studying for tests"

2.6.1.3. Procedure

Ethical approval was secured from the Keele University (see Appendix H). Undergraduate participants were recruited via an online research participation management system. Following sign up participants were directed to the

Qualtrics platform, they were first presented with information about the study and asked to provide their consent to participate (see Appendix I). Following this the instruments were presented in the above order finishing with a debriefing which explained the theoretical motivation behind the study (see Appendix J).

2.6.2. Results

Descriptive statistics for dichotomous 'yes/no' questions are presented in Table 15 below. Descriptive statistics for Likert-style response format questions are presented in Table 16 below. As these data are dichotomous only counts and percentage of responses are provided. All instruments have an acceptable level of internal consistency across all of the coefficients utilised. Histograms of data and distributions are presented in Figure 16 below. As can be seen from the histograms there are no significant outliers or unexpected patterns in the data. Whilst some data from some instruments follow a Gaussian distribution, there is considerable skew on both current and previous instruments, this is not a concern as data will be analysed within the Bayesian framework (Kruschke, 2015).

Table 15.
Descriptive statistics for dichotomous 'yes/no' questions.

Measure	Q	Count 'yes'	Percentage 'yes' (%)
Are some people born clever?	8	38	30.40
Can they change how clever they are?	9	123	98.40
Do you think you can change how clever you are?	10	108	86.40

Table 16.
Descriptive and internal reliability statistics.

Measure	Q	Mean	SD	SE	L95% CI	U95% CI	α	ω	glb
Performance goal	1	2.72	1.15	.10	2.52	2.92	-	-	-
Learning goal	2	4.34	.90	.08	4.19	4.50	-	-	-
Affect following failure	3	3.00	.98	.09	2.83	3.17	-	-	-
Persistence following failure	4	4.71	1.02	.09	4.53	4.89	-	-	-
Affect following success	5	2.15	1.18	.11	1.94	2.36	-	-	-
Persistence following failure	6	3.42	1.23	.11	3.20	3.63	-	-	-
Theory of intelligence	11-16	24.77	4.72	.42	23.94	25.60	.87	.87	.92
Outcome goals	17-19	5.02	3.22	.29	4.45	5.58	.95	.95	.96
Ability goals	20-22	8.62	4.08	.37	7.91	9.34	.86	.86	.87
Learning goals	23-25	17.29	2.98	.27	16.77	17.81	.87	.89	.90
Change-mastery goals	26-28	14.74	3.32	.30	14.15	15.32	.86	.86	.86
Helpless attributions	29-32	17.17	3.33	.30	16.58	17.75	.73	.75	.81
Positive strategies	33-35	15.12	2.54	.23	14.67	15.57	.68	.69	.70
Effort beliefs	36-37	10.29	1.58	.14	10.01	10.57	.86	N/A	N/A

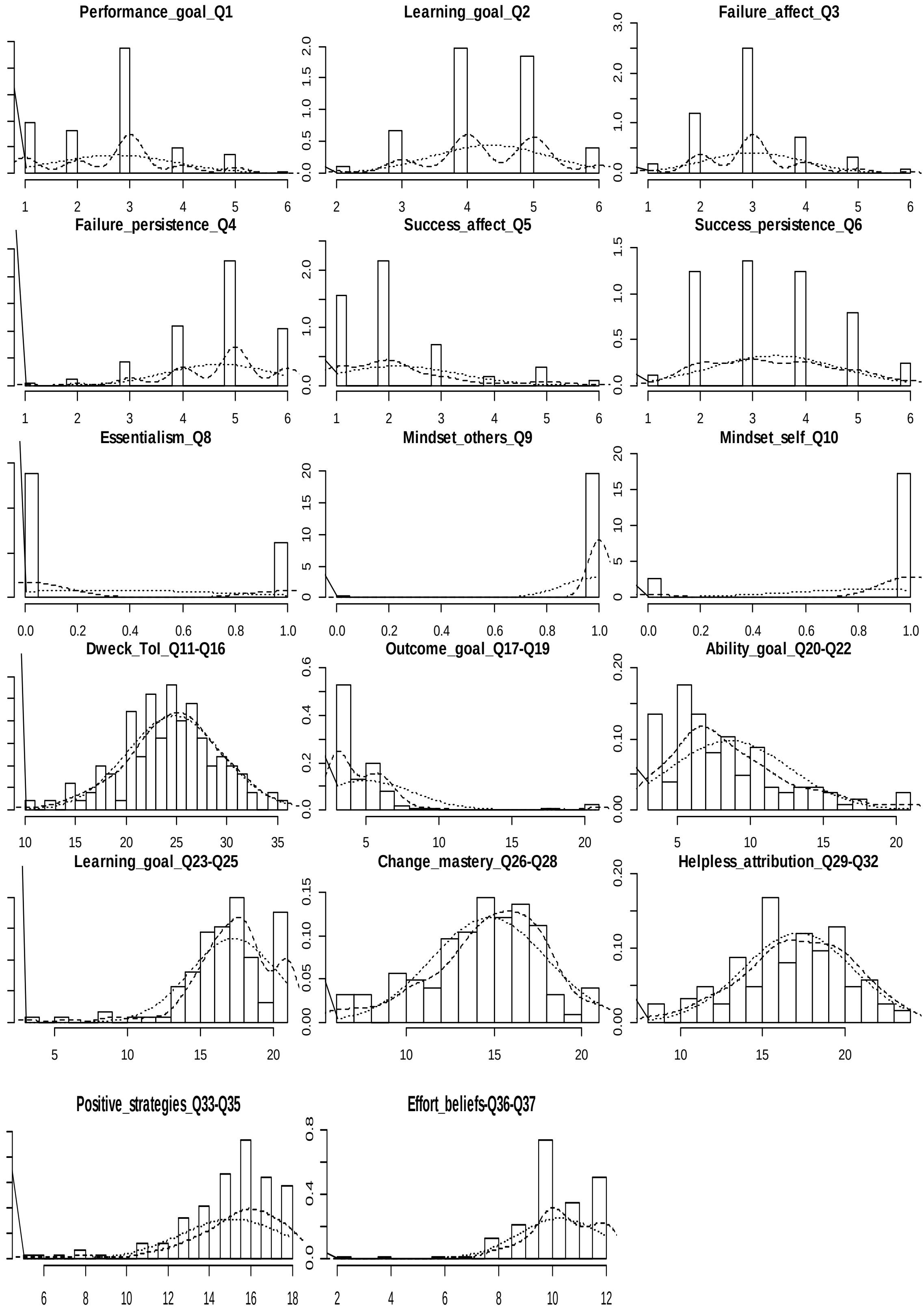

Figure 17. Histogram of all variables. Dotted line = normal distribution. Dashed line = density.

Table 17.
Correlation matrix.

			1	2	3	4	5	6	7	8	9
1	Performance goal	r	—								
		BF_{10}	—								
2	Learning goal	r	-.14	—							
		BF_{10}	.76	—							
3	Failure - affect	r	-.16	-.04	—						
		BF_{10}	1.04	.26	—						
4	Failure - persistence	r	-.08	.17	-.02	—					
		BF_{10}	.34	1.30	.25	—					
5	Success - affect	r	.14	-.14	.04	.03	—				
		BF_{10}	.81	.76	.27	.25	—				
6	Success - persistence	r	.10	.00	-.07	.24	.22	—			
		BF_{10}	.43	.24	.31	8.39	3.89	—			
7	Essentialism	r	-.02	.23	-.02	.03	-.09	.13	—		
		BF_{10}	.25	5.80	.24	.26	.36	.65	—		
8	Mindset - others	r	-.03	-.02	.00	.03	.07	-.06	.08	—	
		BF_{10}	.25	.25	.24	.25	.32	.30	.36	—	
9	Mindset - self	r	-.14	.00	.29	.03	-.07	-.04	.06	.14	—
		BF_{10}	.73	.24	35.95	.25	.31	.26	.29	.70	—
10	Dweck ToI	r	.11	.11	.13	.08	-.04	-.01	.27	.17	.41
		BF_{10}	.48	.50	.64	.35	.26	.24	18.67	1.31	>100
11	Outcome goal	r	-.26	.09	.06	-.02	.11	-.02	-.05	.06	.07
		BF_{10}	13.03	.37	.30	.24	.48	.25	.27	.30	.31
12	Ability goal	r	-.18	.11	.13	-.06	.21	.00	.00	.11	.13
		BF_{10}	1.77	.47	.62	.29	3.26	.24	.24	.51	.64
13	Learning goal	r	.23	.02	-.08	.12	.03	.04	.07	-.03	.01
		BF_{10}	5.09	.24	.35	.58	.25	.27	.32	.25	.24
14	Challenge mastery	r	.24	.20	-.03	.00	.06	.04	.15	.07	-.01
		BF_{10}	8.07	2.59	.25	.24	.30	.26	.85	.31	.24
15	Helpless attribution	r	-.09	.21	.16	.09	.08	.01	.08	.08	.29
		BF_{10}	.39	3.20	1.15	.38	.34	.24	.35	.36	45.21
16	Positive strategies	r	.15	.15	.07	.02	-.07	-.03	-.09	.01	.12
		BF_{10}	.89	.86	.31	.24	.33	.25	.37	.24	.56
17	Effort beliefs	r	.08	.18	-.02	.12	.12	.18	.05	.02	.06
		BF_{10}	.35	1.59	.24	.57	.58	1.72	.27	.25	.29

Table 17.
Correlation matrix continued.

			9	10	11	12	13	14	15	16	17
9	Mindset - self	*r*	—								
		BF_{10}	—								
10	Dweck ToI	*r*	.41	—							
		BF_{10}	>100	—							
11	Outcome goal	*r*	.07	.11	—						
		BF_{10}	.31	.51	—						
12	Ability goal	*r*	.13	.19	.55	—					
		BF_{10}	.64	2.17	>100	—					
13	Learning goal	*r*	.01	.13	-.43	-.35	—				
		BF_{10}	.24	.64	>100	>100	—				
14	Challenge mastery	*r*	-.01	.15	-.02	-.08	.41	—			
		BF_{10}	.24	.88	.24	.35	>100	—			
15	Helpless attribution	*r*	.29	.23	-.11	.15	.07	.15	—		
		BF_{10}	45.21	4.99	.45	.90	.32	.94	—		
16	Positive strategies	*r*	.12	.26	-.21	-.06	.37	.24	.48	—	
		BF_{10}	.56	14.21	3.33	.29	>100	7.14	>100	—	
17	Effort beliefs	*r*	.06	.21	-.16	-.04	.32	.28	.38	.58	—
		BF_{10}	.29	3.35	.97	.26	>100	27.34	>100	>100	—

Correlations between all variables are presented in Table 17. The first stage was to explore the relationships between items within the MMYC. Results showed a similar pattern of relationship between items in the MMYC as in Study 1 and 2. Particularly, there seemed to be limited agreement between mindset items and others. Only mindset self (Q10) and affective response to failure (Q3) had a statistically meaningful relationship, for which there was 'very strong' evidence (i.e. BF_{10} >30 and <100). There was 'anecdotal' evidence (i.e. BF_{10} >1 and <3 - see Wagenmakers et al., 2018) towards a relationship between performance goals (Q1) and affective response to failure (Q3), also between learning goals (Q2) and persistence following failure (Q4). There was also a relationship between persistence following failure and persistence following success (Q5), between persistence following success and affect following success, and learning goals and essentialism (Q8), the evidence for these relationships was 'moderate' (i.e. BF_{10} >3 and <10 - see Wagenmakers et al., 2018). However, a similar pattern of concepts not being related was found in the previous studies and therefore cannot be assumed to be unique to these data.

The Grant and Dweck (2003) instruments (outcome goal, ability goal, learning goal, challenge-mastery goal) are suggested to relate to one another and were considered collectively to begin with. Data suggested that constructs mostly related in a fashion that would be expected, with some exceptions. There was a negative relationship between learning goals (Q23-25), and outcome goals (Q17-19) and ability goals (Q20-22). Which would be expected as they are conceptual opposites. Also, results showed a positive relationship between outcome goals and ability goals (Q20-22). However, challenge-mastery goals (Q26-28) were only positively related to learning goals, as the theory suggest they should be. Yet it would also be reasonable to assume a relationship, if not to the other Grant and Dweck (2003) items, but between challenge-mastery goals and mindset items. Overall, this suggested that even established constructs, measured with established instruments, may not be necessarily be related as would be prescribed by theory.

Next, it was important to examine the results in respect of the convergent validity of the MMYC and existing instruments. Firstly, as all mindset behaviours are driven by theory of intelligence, as per Blackwell et al. (2007), it was logical to examine these results first. Dweck's (2000) instrument related to two items from the MMYC, essentialism (Q8) and self-mindset (Q10), the former having a 'strong' level of evidence (i.e. BF_{10} >10 and <30) and the latter having an 'extreme' level of evidence (i.e. BF_{10} >100). This suggested acceptable levels of convergent validity between the theory of intelligence questions within the MMYC and the Dweck (2000) instrument, shown in both Study 1 and this study. The lack of statistically meaningful relationship between Dweck's (2000) instrument and the MMYC other-mindset (Q9) supports previous findings that there is a differentiation between a self, as opposed to other, mindset.

The MMYC performance goal item was related to all of the Grant and Dweck (2003) instruments, which would be expected as they are all achievement goal focussed items and suggests the MMYC has convergent validity on these constructs. Evidence was 'strong' (i.e. BF_{10} >10 and <30) between MMYC learning goals and outcome goals, 'moderate' (i.e. BF_{10} >3 and <10) for learning goals and challenge mastery orientation, and 'anecdotal' (i.e. BF_{10} >1 and <3) for ability goals. Additionally, there was an 'anecdotal' level of evidence for the relationship between the MMYC learning goals question and Grant and Dweck's (2003) challenge mastery instrument, which would be expected, as they are both conceptually very similar. However, there was no relationship between the MMYC learning goal items and any of the other Grant and Dweck (2003) instruments. This does suggest that achievement goal items phrased in terms of a learning goal have a social desirability element and the MMYC is capturing a learning goal more as a rejection of a performance goal, rather than agreement of a learning goal.

The last comparison in relation to convergent validity to make was between the MMYC and the Blackwell et al. (2007) instruments. There were only two statistically meaningful relationships, for which there is an anecdotal level of evidence to support them (i.e. $BF_{10} > 1$ and < 10). The first of which was between Blackwell et al.'s (2007) helpless attributions instrument and affective response to failure from the MMYC. This relationship is as would be expected. The second is between the persistence following success question from the MMYC and Blackwell et al,'s (2007) effort instruments. Although not directly obvious the relationship does make conceptual sense; respondents who feel sad about continuing at a task they have succeeded at have a growth mindset as they wish to develop their skills.

Finally, it is important to consider the relationships within the framework as proposed by Blackwell et al. (2007) and Burnette et al. (2013). This was done using the extant instruments and not the MMYC to assess whether the framework holds as proposed in the literature. As this Study was a conceptual replication of Blackwell et al. (2007) the relationships between constructs which they proposed were explored first. As both models suggest that the framework originates from an individual's theory of intelligence, in the Blackwell et al. (2007) model (see Figure 2) this suggests two relationships: learning goals and positive effort beliefs. As the Grant and Dweck (2003) set of instruments was used in the current study, all four constructs will be assessed (outcome goal, ability goal, learning goal, and challenge mastery). The construct which Blackwell et al. (2007) employed was learning goals, so it was logical for this to be assessed first. There was not a statistically meaningful relationship between theory of intelligence and learning goals. However, there was a relationship between theory of intelligence and ability goals, this could be owing this construct being a less socially desirable construct or compelling set of items, however, there was only an anecdotal level of evidence to support this relationship. The second relationship of interest stems from theory of intelligence in the Blackwell et al. (2007) model, is effort beliefs, which was supported by data, although there was only a 'moderate' level of evidence (i.e. BF_{10} >3 and <10, Wagenmakers et al., 2018) to support this relationship. According to Blackwell et al. (2007) positive effort beliefs are related to low helpless attributions and positive strategies. Data suggested that both constructs are related in the direction as would be predicted by the theory. The evidence for these relationships, in both cases, was 'extreme' (i.e. BF_{10} >100 – see Wagenmakers et al., 2018). The final relationship within the model is between learning goals and positive strategies. Again, all four constructs from the Grant and Dweck (2003) were considered. Firstly, as it is the construct used in Blackwell et al.'s (2007) model, learning goals were considered first. The relationship was in the direction as would be expected, in that a learning goal predicted more positive strategies, and the evidence for this relationship was 'extreme'. Data did not provide any evidence towards a relationship between ability goals and positive strategies. There was a negative relationship between outcome goals and positive strategies, however, the direction of this relationship was opposite to what would be expected – there was a 'moderate' level of evidence supporting this relationship. Finally, challenge mastery goals related to positive strategies as would be expected, and again, data provided 'moderate' support to this relationship.

The second structure of the framework which was considered is the SOMA model by Burnette et al. (2013). Within the SOMA model there are no mediated relationships, all constructs are directly linked to theory of intelligence. Ability goals and effort beliefs were related to theory of intelligence with an anecdotal level of evidence to support the relationship. With helpless attributions and effort beliefs having a moderate amount of evidence towards their relationship with theory of intelligence (i.e. BF_{10} >3 and <10 – see Wagenmakers et al., 2018). Finally, results showed a strong degree of evidence for a relationship between positive strategies and theory of intelligence (i.e. BF_{10} >10 and <30 – see Wagenmakers et al., 2018). Generally speaking, the correlation matrix suggested that the MMYC performed as expected and demonstrated convergent validity with extant instruments, the Dweck (2000) instrument was robust, the Grant and Dweck (2003) instruments relate to each other as expected, and the Blackwell et al. (2007) instruments do the same. However, they do not all relate together as prescribed by theory. The results thus far present a somewhat unclear picture of the implicit theories framework. However, this could be because the framework is moderated as per Blackwell et al. (2007).

To explore these relationships further two network analyses will be performed. The first investigated the relationship between variables in the MMYC and the second included all of the variables within the current study. The first network analysis is presented in Figure 18 and Table 18, the relationship which remains stable, as in previous analyses, is mindset (others) and mindset (self). However, compared to the previous adult data there is no longer a relationship between learning goals and mindset, but there is now a relationship with affective response to failure and mindset (self).

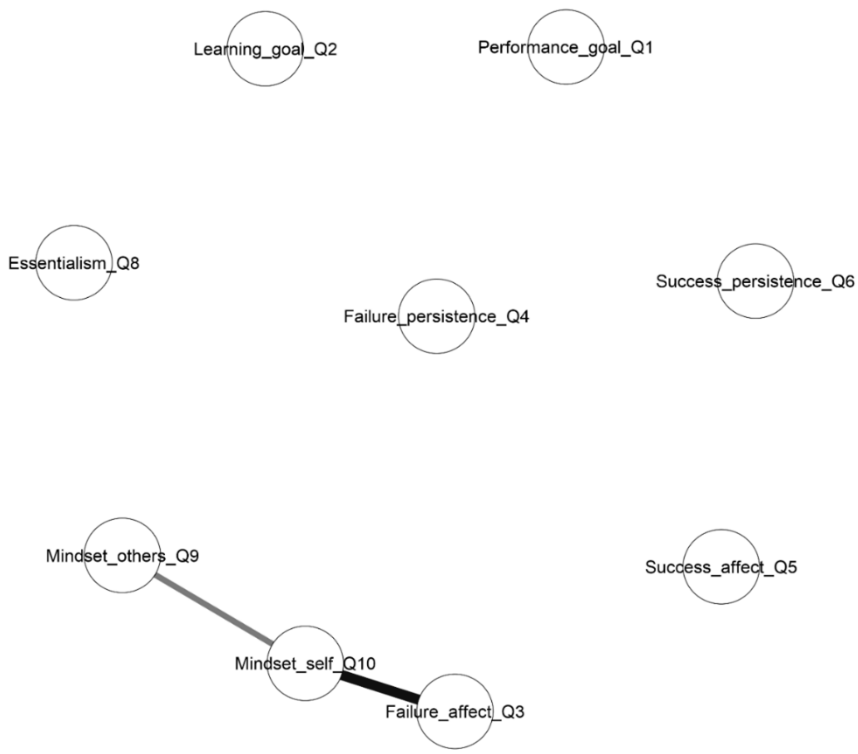

Figure 18. Network analysis path diagram.

Table 18.
Network analysis weights.

	Variable	Q	1	2	3	4	5	6	7	8	9
1	Essentialism	8	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	Failure affect	3	.00	.00	.00	.00	.00	.19	.00	.00	.00
3	Failure persistence	4	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	Learning goal	2	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	Mindset others	9	.00	.00	.00	.00	.00	.11	.00	.00	.00
6	Mindset self	10	.00	.19	.00	.00	.11	.00	.00	.00	.00
7	Performance goal	1	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	Success affect	5	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	Success persistence	6	.00	.00	.00	.00	.00	.00	.00	.00	.00

The second network analysis included all the variables from within the current study. To increase clarity on the network plots the variables are numbered (see Figure 19), when items and/or instruments are referred to in the text below their numbers from this legend will be provided in square brackets (e.g. Ability goals [1]). Weights are shown in Table 19.

In relation to theory of intelligence constructs. There is a stable relationship between Dweck's theory of intelligence instrument [3], the MMYC mindset (self) item [12], and mindset (other) [11]. The relationship between the MMYC mindset self and other is also maintained. There is a strong positive relationship between the MMYC mindset (self) and the MMYC failure (affect) [6] and Blackwell et al. helpless attributions [8], this makes clear theoretical sense as positive emotional and mastery response to failure are proposed in the framework. However, these concepts seem to be distinct from one another.

The Grant and Dweck items cluster together [1, 2, 10, 13], and have relationships which would be as predicted: a positive relationship between challenge mastery goals [2] and learning goals [10], also ability goals [1] and outcome goals [13]. The two clusters of 'positive' and 'negative' learning behaviours are negative linked between outcome goals [13] and learning goals [10]. There is no negative relationship between challenge mastery goals [2] and ability goals [1] as would be suggested by Grant and Dweck, this suggests that conceptually single learning and performance goals are potentially the most parsimonious option. The two persistence items from the MMYC, following success [17] and failure [7] are also independently related. There is no relationship between the MMYC learning goal item [9] and the Grant and Dweck learning goal instrument [10].

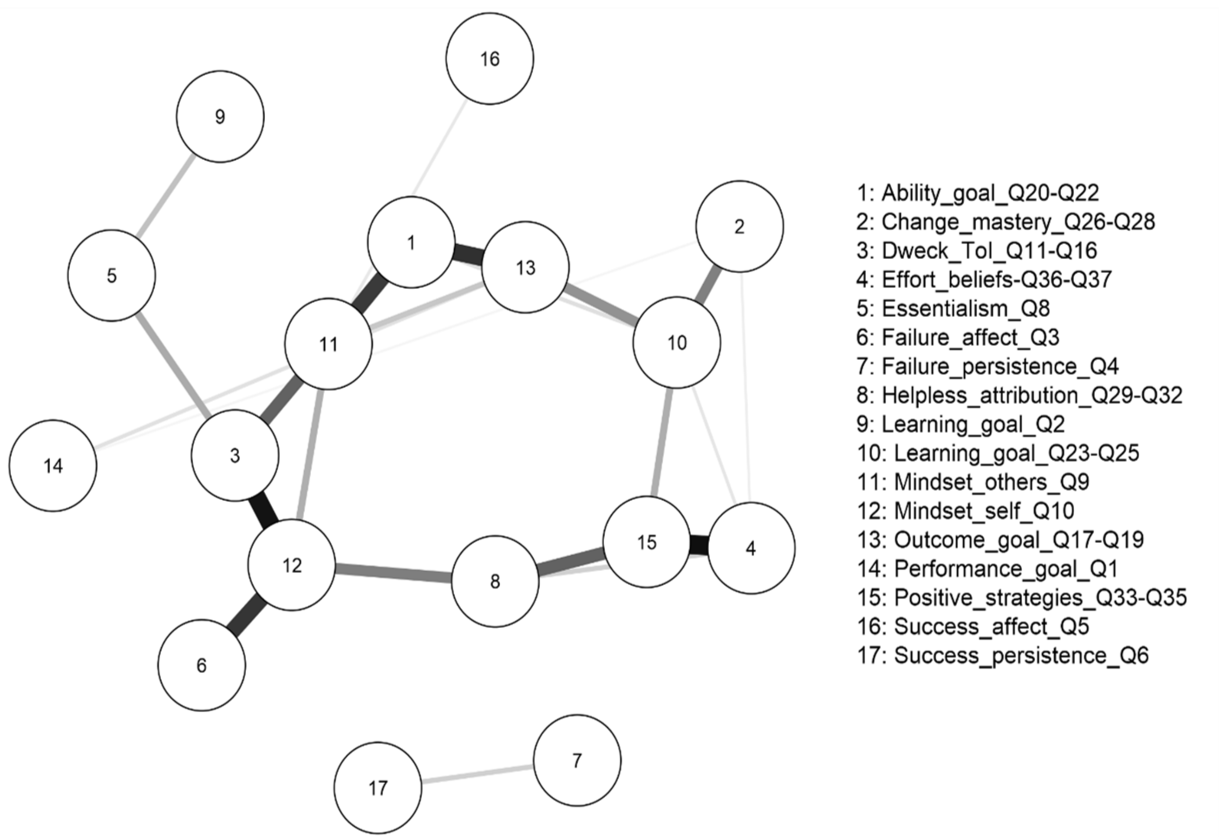

Figure 19. Network analysis path diagram.

Table 19.
Network analysis weights.

	Variable	Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Ability goals	20-22	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.05	.25	.00	.26	.00	.00	.00	.00
2	Challenge mastery	26-28	.00	.00	.00	.02	.00	.00	.00	.00	.00	.16	.00	.00	.00	.01	.00	.00	.00
3	Dweck ToI	11-16	.00	.00	.00	.00	.11	.00	.00	.00	.00	.00	.20	.30	.00	.00	.00	.00	.00
4	Effort beliefs	36-37	.00	.02	.00	.00	.00	.00	.00	.06	.00	.03	.00	.00	.00	.00	.31	.00	.00
5	Essentialism	8	.00	.00	.11	.00	.00	.00	.00	.00	.08	.00	.00	.00	.00	.00	.00	.00	.00
6	Failure - affect	3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.26	.00	.00	.00	.00	.00
7	Failure - persist	4	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06
8	Helpless attr'n	29-32	.00	.00	.00	.06	.00	.00	.00	.00	.00	.00	.00	.16	.00	.00	.20	.00	.00
9	Learning goal	2	.00	.00	.00	.00	.08	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	Learning goal	23-25	-.05	.16	.00	.03	.00	.00	.00	.00	.00	.00	.00	.00	-.15	.00	.10	.00	.00
11	Minset - others	9	.25	.00	.20	.00	.00	.00	.00	.00	.00	.00	.00	.10	.07	.00	.00	.03	.00
12	Mindset - self	10	.00	.00	.30	.00	.00	.26	.00	.16	.00	.00	.10	.00	.00	.00	.00	.00	.00
13	Outcome goals	17-19	.26	.00	.00	.00	.00	.00	.00	.00	.00	-.15	.07	.00	.00	-.04	.00	.00	.00
14	Performance goals	1	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-.04	.00	.00	.00	.00
15	Positive strategies	33-35	.00	.00	.00	.31	.00	.00	.00	.20	.00	.10	.00	.00	.00	.00	.00	.00	.00
16	Success - affect	5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	.00	.00	.00	.00	.00	.00
17	Success – persist	6	.00	.00	.00	.00	.00	.00	.06	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

To replicate the model as proposed by Blackwell et al. (2007) structural equation modelling was completed in the *lavaan* package (Rosseel, 2012) in R (R Core Team, 2016). These analyses were completed within the frequentist framework as to be more readily comparable to the original results. As this study did not include any academic performance data as the Blackwell et al. (2007) study had, the positive strategies variable was specified as the ultimate endogenous variable (i.e. the predicted variable). With learning goals, incremental theory, effort beliefs, and low helpless attributions as exogenous variables (i.e. the predictor variables), these were all latent variables. As per Blackwell et al. (2007), the covariance between learning goals and positive effort beliefs was also modelled. Implicit theory was indexed by the six items listed above, three entity items and three incremental (reverse coded); learning goals were indexed by the three learning goals items. Positive effort beliefs were indexed by two items. Low helpless attributions were indexed by four items, and positive strategies by three items.

The Comparative Fit Index (CFI), the Root Mean Squared Error of Approximation (RMSEA), and the Standardised Root Mean Squared Residual (SRMR) were used to evaluate model fit. Values below .90 for the CFI and above .08 for the RMSEA and SRMR, additionally if the χ^2 test is significant this indicates unacceptable fit between a specified model and observed data (MacCallum, Widaman, Preacher, & Hong, 2001). However, the current sample size is not large, and some elements are not normally distributed. Therefore, a statistically significant χ^2 test statistic can be acceptable if other absolute fit indices are acceptable (Schermelleh-Engel & Moosbrugger, 2003). The model fit results were thus: χ^2 = (125) 236.97 p <.001, CFI = .876, RMSEA = .083 (90% CI [.066, .099]), SRMR = .088. This suggested that the model was not a good fit to data. Therefore, the modification indices were inspected to asses any areas of the model may have been mis-specified. The largest modification index was found between Question 5 and Question 6 the Dweck (2000) Theory of Intelligence instrument (MI = 33.29). These items are conceptually and theoretically related; they are both items reflecting and incremental theory of intelligence perspective (see Section 2.6.1.2.4 for details). Question 2 also presents an incremental theory of intelligence proposition. The modification indices of the covariance between Question 2 and 6, and Question 2 and 5 were small (MI = 2.69 and MI = 1.16, respectively). However, for theoretical completeness the residuals between these three pairings was specified in the model. This produced a model with acceptable fit to data: χ2 = (125) 193.74 p <.001, CFI = .922, RMSEA = .067 (90% CI [.048, .084]), SRMR = .082.

Most relationships within the model have a statistically meaningful relationship except for incremental theory predicting learning goals, further suggesting that the relationships between constructs as prescribed in the literature are not as robust as suggested (see Table 20 for model outputs). It is important to consider not just the model fit or whether the paths are statistically significant but also how the regression weights found in the current study compared to those from Blackwell et al. (2007). Table 20 includes the Blackwell et al. (2007) weights in the “Original Estimate” column, which are compared to the current estimates in the “Difference” column. It isn’t possible to statistically compare the models without the original data; however, it is notable that all relationships except for positive strategies relationship with helpless attributions and learning goals have a substantial difference.

Table 20.
Path model: regression weights.

	Q	Est.	SE	Z	*p*	Orig. Est.	Diff.
Positive strategies							
Helpless attributions	29-32	.37	.10	3.68	<.001	.25	.12
Effort beliefs	34-35	.56	.12	4.87	<.001	.77	.21
Learning goals	23-25	.19	.08	2.29	.022	.15	.04
Learning goals							
Incremental theory	11-16	.15	.12	1.20	.231	.59	.44
Effort beliefs							
Incremental theory	11-16	.31	.12	2.63	.008	.80	.49
Helpless attributions							
Effort beliefs	34-35	.49	.13	3.84	<.001	.77	.28

N.B. Est. = Estimate, Orig. Est. = Original Estimate, Diff. = Difference. Coefficients reported are standardised.

2.6.3. Discussion

The primary motivation of this study was to explore if the MMYC had convergent validity with extant instruments or if the framework did not hold as prescribed. The results suggested that previously discovered relationships between the theory of intelligence elements of the MMYC and Dweck's (2003) instrument still hold, and to a similar degree as in the first study of this chapter. This suggests that the MMYC consistently and reliably measures an individual's theory of intelligence. Other relationships were also uncovered between the MMYC and other extant instruments. Such findings suggest that the MMYC accurately measures the constructs which it was designed to measure. The second part of this study aimed to explore whether the constructs within the framework relate as prescribed in the literature, data suggested that the framework did not fit together as expected. The conceptual replication of Blackwell et al. (2007) path model failed;one path was not statistically meaningful, and some of the regression weights were quite different from the original model. Network analyses further suggested that concepts within the framework do not relate as prescribed. Therefore, whilst the MMYC may usefully measure the constructs under investigation, the relationships between those constructs did not seem to replicate.

It is possible that the conceptual replication of Blackwell et al.'s (2007) path model failed because their model had academic performance as the ultimate endogenous variable whereas in the current study the path terminated at positive strategies. Additionally, as this was a conceptual replication alternative instruments were used. Changing the structure of a path model, even by a single variable, can alter a model's fit to data (Barrett, 2007). However, this is the purpose of a conceptual replication - if the model has verisimilitude (i.e. a likeness to reality or truth) then it follows that it should be replicable using different instruments; it is the same as measuring a length using inches or centimetres (Hüffmeier et al., 2016). Importantly, both the SOMA model (Burnette et al., 2013) and the Blackwell et al. (2007) model feature theory of intelligence as a primary or originating variable of other associated behaviours within mindsets, meaning that all other behaviours originate from the individual theory of intelligence. The relationship between theory of intelligence and all other mindset behaviours and cognitions is the corner stone of the self-theories framework as put forward by Dweck (2000). However, the current study has subjected this concept to a variety of tests and found limited supportive evidence towards this.

The three analyses presented above allow three different conclusions to be drawn. Within the correlation analysis, data can be compared internally within the MMYC, within the conceptual replication, and between the MMYC items and extant instruments. Within the MMYC, one theory of intelligence item, essentialism ("Are some people born clever?"), was related to learning goals and none were related to performance goals. Within the conceptual replication, Dweck's (2000) theory of intelligence instrument was related to learning goals. This relationship was positive, however, all items were recoded so that a higher score denotes a growth mindset. Therefore, this relationship is opposite to findings reported by Dupeyrat and Mariné (2005); incremental theories of intelligence are negatively related to performance goals, as opposed to entity theories being negatively related to learning goals. Finally, the MMYC performance goal item was related to Grant and Dweck (2003) performance goal instruments (outcome and ability), and performance goals (learning and challenge mastery). The direction of these relationships was as expected, that lower MMYC performance goal scores were related to lower outcome and ability scores, and higher learning goals and challenge mastery scores. However, the MMYC learning goal item was only statistically related to challenge mastery scores from Grant and Dweck (2003). What this suggests is that the failure described by the scenario of the MMYC learning goal item may be too compelling, and participants, regardless of a learning goal orientation may wish to avoid failure. Therefore, those with a growth mindset may reject a performance goal and also reject the failure presented in the learning goal item.

The Blackwell et al. (2007) instruments to measure helpless attributions, positive strategies, and effort beliefs were used in the conceptual replication. As before, the relationships within the MMYC will be explored first. Between the four items, persistence following success is related to persistence following failure and affect following success. Affect following failure is not related to any of the items in the correlational analyses. This may be because, as with the learning goal item from MMYC, a failure scenario is too compelling to participants. Although a positive response to failure is a feature of a growth mindset (Burhans & Dweck, 1995). However, this is supported in the correlational analysis and two network analyses, affect following failure is strongly related to mindset self. Within the conceptual replication, helpless attributions, positive strategies, and effort beliefs are all related to Dweck's (2000) theory of intelligence instrument in the correlational analyses, they are also strongly related to each other. However, this pattern does not hold in the network analyses, as they were more closely related to the MMYC items. In terms of the convergent validity of the MMYC items, helpless attributions were related to affect following failure and effort beliefs with persistence following success. There are not items within the MMYC which effort beliefs would map onto, so it is unsurprising no relationship was found.

2.7. Conclusions

In conclusion, the primary motivation of the studies outlined in this chapter were to produce an instrument to measure young pupils' mindsets. Considering the capacity of young children to engage with complex concepts, the instrument was designed with both theory on intelligence instruments and proxy measures for behaviours associated with an implicit theory of intelligence. The instrument was designed to be administered by educators in parallel with literacy tests undertaken as part of the Stoke Reads programme. Trials found the instructions and instrument to be appropriately accessible and clear to allow precise administration by facilitators with no training and young pupils were able to comprehend the questions and provide responses. Overall, the instrument takes less than five minutes to administer per pupil. From a psychological measurement perspective, the data from the current study suggests that the MMYC has convergent validity with previous, multi-item instruments designed to capture the same constructs. However, the studies suggest that the self-theories framework as put forward by Dweck (2000) does not hold.

There are items within the MMYC which could potentially be removed whilst maintaining the usefulness of the instrument. For example, learning goals may be sufficeintly captured by their ‘negative’ counterpart – performance goals. The utility of items which have negative social desirability within the measurement of implicit theories of intelligence is not new (see Hong, Chiu, Dweck, Lin, & Wan, 1999). However, the current brevity of the MMYC with ten items is palletable for use in conjunction with the testing Stoke Reads undertake. As the framework appears somewhat unclear, the risk of losing proxy measures, and therefore routes into developing understanding of pupils motivations in education is too great to consider reducing the instrument further. Future research should investigate this possibility.

On the point of the relationships between the constructs, there is an ongoing debate as to the structure of the self-theories framework which is yet to be resolved, a debate which only seems to engage a small handful of researchers (Lüftenegger & Chen, 2017). Resolving this issue is both beyond the scope of the current research. Considering the evidence from Study 3, the MMYC has sufficient convergent valididity to be a useful instrument to measure young children's mindsets. Evidence from all three studies suggests that the theoretical framework does not hold quite as prescribed by the literature. This could be because mindsets are, as research shows, highly sensitive (e.g. Cimpian et al., 2007) meaning that mindsets could potentially be in a permanent state of flux. Additionally, the majority of research thus far has depicted a bipolar construct, that individuals exclusively hold either a growth or fixed mindset (e.g. Dweck et al., 1995). However, other research has suggested that this is not necessarily the case (e.g. Tempelaar et al., 2015). Researchers are only now beginning to argue for clearer definitions and recognition of the conceptual issues within the framework and lack of empirical work exploring this (Lüftenegger & Chen, 2017). Arguably, to accurately measure any construct it is critical for that construct to be precisely defined (Flake & Fried, 2019). As such, the likely path based relationships within the framework will be taken into consideration in future analyses and the MMYC will be used in its current form.

There is a significant history and volume of work published on 'mindsets'; in fact Dweck and Reppucci "Learned helplessness and reinforcement responsibility in children " (1973) was Dweck's first publication. Nearly 900,000 articles are returned when searching academic databases for "implicit theories of intelligence" and "growth mindsets". However, data such as these from the current chapter suggest that growth mindsets may not be quite as depicted by Dweck (2000) are not isolated (Lüftenegger & Chen, 2017). Indeed, Dweck has recently discussed the ongoing development of her and her colleagues' understanding of mindsets and their influence on education (Dweck, 2017). Yet, there is strong evidence that having a growth mindset is educationally, and indeed socially, beneficial for pupils (Claro et al., 2016; Yeager et al., 2016). Costa and Faria (2018) found subject specific mindsets were a moderating factor on academic achievement (e.g. a 'maths mindset'). What is apparent is that many studies are based upon varied conceptualisations of the framework and associated constructs, and operationalisations thereof (Costa & Faria, 2018; Dickhäuser et al., 2016; Dupeyrat & Mariné, 2005).

As highlighted by Yeager et al. (2018) in their pre-registered, random allocation trial, of a brief (~50 minute) internet-based growth mindset intervention, even the 'seemingly negligable' three percent reduction in adolescents failing to graduate high school would translate to 100,000 additional high school graduations annually in the United States. However, research such as this often only utilises Dweck's (2000) implicit theories instrument and fails to capture variables such as academic goals or responses to failure (Costa & Faria, 2018). Regardless, the 'core' tenet of a growth mindset – a belief that intelligence is malleable and can be developed, seems to be positively predictive of educational achievement (e.g. Claro et al., 2016). As Meehl (1990) highlights, no theory is perfect, however, a theory may have sufficient versimilitude (i.e. representation of the truth) and a sufficient quantity of evidence or "money in the bank" (p. 115) that it can be appropriate to adopt a Lakatosian retreat. In other words, to return to the 'core' of the theory and reappraise the state of the theory; in this case how implicit theories of intelligence relate to the other elements of the framework and how these all related to learning. It would seem that this is the most appropraite course of action for mindset researchers. In summary, in the context of the current research the MMYC performs adequately and there is no reason to assume that promoting growth mindsets will not have educational benefits. However, future research must address the conceptualisation and operationalisation of the peripheral constructs within the framework and how they relate to each other and also to educational performance.

3. Intervention Development

This chapter sets out the development process which resulted in the Stoke Reads Mindset Kit (Mindset Kit). It begins by providing an overview of the context that the current research took place in and the constraints that this entailed. A review of design and intervention strategies is then presented, culminating in the adopted design criteria that guided the subsequent development process. The second part of this chapter covers the design process of the Mindset Kit. It describes the approach which was adopted in the current research which engages academics with practitioners and other non-academic experts, and how these individuals were recruited. The chapter will culminate with an assessment of whether the final product met the original design considerations.

3.1. Initial Design Ideas and Considerations

This section will explore the key considerations which needed to be incorporated into the final product. These came from our local partners and funders, and from the literature.

3.1.1. A 'legacy' product

This thesis was part funded by 'Stoke Reads', a programme developed by the City of Stoke-on-Trent Council. Stoke Reads was set up to both enhance literacy teaching within schools and nurseries and also to create a city wide 'buzz' around reading. This was achieved via a network of peers who met regularly to share best practice and attend expert training. Stoke Reads was setup and initially funded for a period of three years (2015-18). This was during a time of funding uncertainty for local authorities (Smith, Phillips, Simpson, Eiser, & Trickey, 2016). Because of the uncertainty about the length of the project, the Stoke Reads steering group decided that all outputs from the programme should form a 'legacy' of the programme. This meant that outputs should be accessible, and practitioners should be able to use them without any training. Thus, if funding were to be unexpectedly withdrawn, pupils within the City could still benefit from the programme. Therefore, a key consideration for the Stoke Reads Mindset Kit is that it must be easy for teachers to use without extensive training and resources.

3.1.2. The need to generate a classroom culture

It is important to recognise the various structural systems which influence a child's development are nested within each other (Bronfenbrenner, 1979). And that where possible interventions should target multiple levels rather than focussing on the individual.

This is important because mindsets are sensitive; research has shown that mindsets can be changed by seemingly subtle linguistic differences (Cimpian, Arce, Markman, & Dweck, 2007). For example, "You are a good drawer" as opposed to "You did a good job drawing" can promote a fixed or growth mindset respectively. As younger children (i.e. zero to three years of age) learn through social modelling, how their parents respond to failure can also influence their mindsets (Haimovitz & Dweck, 2016). The environments which children grow up in have been shown to significantly and enduringly influence their mindsets (Haimovitz & Dweck, 2017; Gunderson, Sorhagen, Gripshover, Dweck, Goldin-

Meadow, & Levine, 2018). With mindsets being so sensitive, and pupils' home environment having a substantial bearing on their mindset, it is necessary to generate a growth mindset 'culture' within their classroom, and ideally the whole school. Should they then receive stimuli which promotes a fixed mindset from any source, upon returning to school, the growth mindset message will be embedded and help to counteract this. In taking a 'cultural' approach as opposed to developing a time-limited intervention, pupils are most likely to have a robust growth mindset throughout their education.

This contrasts with time-limited, on-line growth mindset interventions (e.g. Paunesku et al., 2015) which are delivered solely to the pupil. Such interventions generally offer short on-line sessions to pupils, e.g. ~50 minutes (Yeager et al., 2018). These studies are often randomised at the pupil level meaning that within the same school there are pupils in the control and experimental conditions. Approaches like this run the risk of competing with the school culture, for example, high-stakes testing promotes fixed mindsets as it focusses on the product as opposed to the learning process (Shim, Cho, & Cassady, 2013). Within the school, pupils who received such an intervention and gained a growth mindset would be subjected to structures, practices, and social environments that promote fixed mindsets. Therefore, it is critical to change the culture within a school, or at least within the classroom, to promote growth mindsets.

3.1.3. Train the trainer model

The initial strategy for the intervention was that of a train-the-trainer model. Such an approach often involves an expert providing instruction to a group, who will also be simultaneously trained to train others (Pearce et al., 2012). Schools which were involved in Stoke Reads had a 'link' teacher who was involved in peer support and attended network meetings and already had a role in disseminating good practice from the meetings. Our initial plan was that this link person would receive the training and, in turn, provide training to colleagues within their school. It was considered that this could potentially leverage the most engagement from teachers towards developing growth mindset cultures within their schools. This was hypothesised because teachers feel that training from peers is relevant, delivered by someone who is competent, and provides them with autonomy in its application, in that it is not too prescriptive (Aelterman, Vansteenkiste, Van Keer, & Haerens, 2016).

However, there are potential issues in relation to any train-the-trainer model within the current UK education landscape. Every trainer requires instruction to a level sufficient to understand the concepts of the intervention and feel able to train other colleagues. The first issue is that of cost. This relates to the cost for experts to deliver the initial training and the subsequent time cost required to effectively cascade this to colleagues across schools. The second issue lies in the process of cascading the intervention through schools. How well the messages of an intervention are communicated to the intended recipient is described as the fidelity of the intervention (Gearing et al., 2011). The trained teacher would have their own interpretation of the training they received. They would then go and train teachers within their schools who would also have their own interpretation. This double layer of interpretation presents a significant risk of decreasing the fidelity of the intervention. Therefore, to maintain fidelity in a train the trainer model, it would be critical to adhere to activities or approaches with strict protocols.

Indeed, Dweck has outlined how growth mindsets are much more complex than her and her colleagues' initial understanding of them (Severs, 2019). Promoting growth mindsets has become highly popular. A simple Google Scholar search for 'growth mindset' returns 50,300 articles, and a wider internet search provides 5,370,000 results. It has been the subject of large randomised controlled trials in the U.S.A. (Yeager et al., 2018), developed into teacher training programmes in the U.K. (Education Endowment Foundation, 2018), and countless 'home grown' approaches to implementation from teachers and schools alike. Whatever form the current intervention took it was important to recognise the potential for the intervention to be misinterpreted. Whilst growth mindsets may at first appear to be very simple to implement, individual interpretations of the best way to do this may vary. Often this can result in children being directly rewarded for demonstrating 'growth mindset behaviours' resulting in classrooms being segregated not by achievement or behaviour but by mindsets. Furthermore, some interventions have been developed where key elements of mindsets are misconstrued, for example, teachers have offered process praise as a consolation for lack of ability or offered so much praise that it became less effective (Dweck, 2015). The intervention needs to clearly explain the approach which it requires teachers to create whilst still allowing flexibility of interpretation for each individual teacher who engages with the materials.

Furthermore, while this research was being conducted, the UK experienced an unusually high level of turnover of labour within the education sector. This was a multi-faceted problem. Government targets for recruitment onto teacher training were not being met, and teachers were unlikely to remain in the profession post qualification (Worth, Lazzari, & Hillary – 2017; National Audit Office – 2017). Furthermore, teachers in schools serving the most economically disadvantaged areas were less likely to stay in the profession (Allen, Burgess, & Mayo, 2018; Ylimaki, Jacobson, & Drysdale, 2008). These issues were particularly pertinent in Stoke-on-Trent, as the area is economically deprived and therefore presents a challenging environment to practice education in (Gill, 2015). The somewhat transient nature of the education workforce within Stoke-on-Trent presented many potential problems in developing an intervention that required training. Whilst the initial goal was to create a sufficiently large population of teachers who were trained in the intervention, it would be impossible to guarantee that this population would remain in the profession to support teachers in future. An additional issue is that should one school experience a higher level of turnover then their link teacher would have many colleagues to train.

3.1.4. Lesson plans

The initial conception of the Mindset Kit was based around the idea of 'mindset lessons'. Previous studies have effectively implemented classroom lessons to promote growth mindsets in pupils (e.g. Blackwell et al., 2007). However, it is potentially problematic to ask teachers to spend time on lessons that are not part of the National Curriculum as teachers report that they are struggling to cover all aspects of the National Curriculum in the time they have available (National

Union of Teachers, 2014). A solution would be to tie the 'mindset lessons' to areas of the National Curriculum so that teachers would be able to cover curriculum content in lessons that had been designed to promote growth mindsets. For example, when learning about the brain, students could learn about brain plasticity. However, this could potentially limit the life span of this element of the intervention. Following the Education Reform Act of 1988, the UK National Curriculum is set by the Department for Education (McNamara, 1993). Since its introduction the National curriculum has been modified in 1995, 1997, 2007, 2008, 2010, and 2015 (Hanson, 2018). It is likely that changes to the National Curriculum will continue as education remains a highly politicised area of policy. Changes are often made to 'sweep away' the 'mistakes' of previous Governments (Gunter, 2015). These frequent changes would most likely mean the lessons were no longer relevant to the National Curriculum and became a burdensome element of the intervention. This would reduce the likelihood of them being utilised.

Another potential issue of developing lesson plans which are tied to the National Curriculum is the age of pupils which the current intervention is targeting. Previous interventions such as Blackwell et al. (2007) delivered lessons explicitly designed to teach pupils about growth mindsets. The content of which would be inappropriate for the young pupils the current intervention is designed to be used with. Table 21 below presents the content of the lessons Blackwell et al. (2007) provided for their experimental group:

Table 21.
Mindset lessons

Sessions	Experimental group
1 and 2	*The Brain – Structure & Function*: Brain Anatomy, Localisation of Function, Neuronal Structure, Neurotransmission
3 and 4	*Incremental Theory Intervention Reading* (aloud in class): "You Can Grow Your Intelligence"
5 and 6	*Anti-Stereotyping Lesson*: Slides, activity, discussion to illustrate the pitfalls of stereotyping
7 and 8	*Discussions*: Learning makes you smarter; Labels (e.g., stupid, dumb) should be avoided

Note. Adapted from "Implicit theories of intelligence predict achievement across an adolescent transition: a longitudinal study and an intervention," by Blackwell, et al., 2007, *Child Development, 78*, p. 255.

This level of content would be inappropriate for Year 1 children. It is also not realistic to change the content to be age appropriate. Pupils as young as four would not be able to understand that the brain is comprised of neurons, how these communicate, and that results in a 'plastic' brain structure. This means that fully half of the lessons in Blackwell et al. (2007) would be impossible to deliver in the current project. Furthermore, whilst it could be possible to have discussions surrounding stereotypes with young children, it would require a high level of understanding and discussion to successfully promote growth mindsets. This potentially could exclude pupils of lower abilities, those who have special educational needs, or those who speak English as an additional language. Delivering such lessons would also require a significant level of teacher skill in ensuring sessions successfully promoted growth mindsets. This would require an intensive period of training to familiarise teachers with the material and the techniques required to shape discussions towards promoting growth mindsets.

3.1.5. A 'minimal resource' approach

The concept of a 'minimal resource' approach has one definition and several meanings as a design consideration within this thesis. 'Resources' refers to any cost to a school budget, this is taken as both directly financial (i.e. requires the purchase of materials, equipment, or training) and staff time (i.e. teachers time costs the school). This is particularly relevant as funding for UK schools grows ever tighter within current austere fiscal policy, forcing schools to make efficiency savings wherever possible (Andrews & Lawrence, 2018). To introduce an intervention into schools which would require significant resources, or indeed any resources at all, would potentially be an unbearable cost for schools. This would render the intervention at best only useful for a small portion of schools or at worst, completely untenable for all schools. Therefore, an important design consideration was that the intervention be 'minimal resource' without compromising outcomes for pupils.

3.1.6. Continued engagement from teachers

As outlined above, teachers face significant pressures in their workload (National Union of Teachers, 2014). Therefore, it was important to consider how teachers would interact with the Mindset Kit. Producing a substantial intervention (e.g. a ring binder as is common for educational programmes) could appear overwhelming, meaning teachers may not follow the suggestions fully, and as discussed above – may promote 'false' growth mindsets. If the messages contained within the Mindset Kit could be communicated from the first reading then this would avoid such issues, teachers could then refer to the Mindset Kit as they updated their practice. It was also important to consider how to encourage teachers to continue implementing the ideas within the Mindset Kit after their initial engagement, i.e. halfway through a school year. Creating an intervention that teachers could easily reengage with would increase continued fidelity of the ideas of the intervention.

3.2. The Design Process

To guide the design process a hierarchy of priorities was set, thus ensuring the project met all requirements from all stakeholders:

1. Generate a classroom culture
2. Provide appropriate guidance/teacher endorsement
3. A 'legacy' product
4. A 'minimal resource' approach
5. Continued engagement from teachers

Critically the primary design consideration was how to effectively communicate a rich body of literature to teachers in a fashion that would allow them to effectively and easily promote growth mindsets in their classrooms. The rich theoretical literature surrounding mindsets provide an excellent basis from which to design an intervention but offers little guidance about how best to achieve this. As previously discussed, almost all existing interventions work with secondary school aged children or older children. There was very limited work looking at interventions with young children.

There is a limited selection of distinct methodologies designed to facilitate the translation of findings from experiments into effective interventions. The 'traditional' approach is that academics, being experts in theory and the intended effects of the intervention, design an intervention and then conduct a study to evaluate whether it achieves the desired outcomes (Halskov & Hansen, 2015). This is often done through the 'gold standard' of a randomised control trial, in which participants are randomly allocated to either a control or experimental condition. Data are collected at a minimum of pre and post-test, often with many more occasion measurements taken (Grossman & Mackenzie, 2005). However, the exclusive perspective of academics in the development of an intervention is potentially problematic. Academics are unlikely to be practitioners within the field the intervention is designed to target and often act as onlookers, considering a priori categories to create universal, context-free knowledge (Evered & Reis, 2011). Therefore, such approaches will often fail to provide optimal solutions, making them unworkable in practice or less effective than if they had consulted with practitioners during the development stage.

Recent research by Yeager et al. (2016) attempted to overcome these limitations by employing 'design thinking' in the development of an internet-based growth mindset intervention. They utilised *user centred design* and *A/B testing*. *User centred design* places the user's perspective at the centre of the process. To do this, designers provide 'minimally viable' prototypes to users who provide feedback, the designers then use this feedback to develop an improved product. A/B testing is an iterative approach to development; as aspects of the design are changed, their influence on the targeted outcome is tested. Combining the two approaches as Yeager et al. (2016) did would capture teachers' perspectives, however, it potentially creates a power imbalance between the researcher and the user. During user centred design, opinions on the 'product' are sought from the end-user. This maintains the researcher in a position of power as users are participants in a process controlled by academics, rather than being active participants helping to create the intervention themselves. Such a structure may inhibit users (teachers) in contributing fully to the process, i.e. feeling unable to critique the 'product'. Furthermore, it would not be practical to A/B test the current intervention. Promoting growth mindsets requires time to be realised and would also require a large secondary pool of schools willing to engage in this stage of development making it impractical within the context and scope of the current research.

Another approach that has gained popularity in recent years is that of co-creation or co-design. In the current research co-creation will be considered as the *active involvement* of end-users in the design process (Vargo & Lusch, 2004). This is a more engaged approach than that of user centred design, as all participants are considered equal in the process and design ideas from all members are given equal consideration in the design process. Often this includes stakeholders from several different groups or perspectives engaged in participatory workshops which are designed to stimulate interactions and features continuous dialogue between all members throughout the design process (Ramaswamy & Gouillart, 2010). This conceptualisation is synonymous with the definition provided by Sanders and Stappers (2008), "The authors take *co-creation* to refer to any act of collective creativity, i.e. creativity that is shared by two or more people." (p. 6).

All the approaches described above would facilitate the production of an intervention. However, the 'traditional' approach has the least potential advantages as it does not include any interaction with expert partners in the design process. Whilst user centred design with A/B testing would facilitate feedback from expert partners it would not directly engage them in the design process. By including expert practitioners directly in the design process the intervention would gain their expertise and credibility, which as evidenced above, is key for interventions used by teachers. Therefore, the design process utilised in the development of the Mindset Kit was co-creation. Further considerations and description of the process adopted will be provided below.

3.2.1. Participants

It was essential to include many individuals with expertise and experience in delivering and designing interventions in the co-creation process. Participants were recruited through several approaches depending on where the participants were recruited from.

3.2.1.1. Teachers from within Stoke Reads.

Initially a call went out asking for volunteers to help develop a toolkit which would become a part of the Stoke Reads offering. This was done at Stoke Reads meetings and via the mailing list to the whole group. One teacher was recruited through this method. This teacher was a very experienced teacher who had taught from pre-school through to Key Stage 2.

3.2.1.2. Teachers outside of the Stoke Reads group.

An e-mail was sent to teachers with which I and my supervisor had an existing relationship with. This was done to increase the number of teachers included in the co-creation team and to avoid a potentially Stoke-on-Trent centric teacher base. One teacher was recruited using this method. However, this was a teacher who I had previously worked with on a feedback-based intervention to promote growth mindsets, who was very keen to work with us. This was a huge bonus because they brought a wealth of experience in promoting growth mindsets in pupils.

3.2.1.3. Academics

A call was put out to colleagues within the School of Psychology at Keele University. One academic was recruited from this process. With significant workload commitments this academic offered a single review of the Mindset Kit during the final cycle. This academic brought expertise in the psychology of education and familiarity with the implicit theories field.

3.1.2.4. Other professionals from Stoke Reads

An early years reading specialist and a speech and language therapist were recruited from within Stoke Reads. This was done via direct contact at Stoke Reads meetings. Only the early years reading specialist attended the initial co-creation meeting. The early years reading specialist was also an experienced primary school teacher. They also had significant experience in delivering interventions directly with pupils and across schools.

3.1.2.5. Consent

Ethical approval was granted by Keele University (see Appendix K). Information sheets were sent electronically to participants once they had expressed interest (see Appendix L). Once all participants had expressed their willingness to continue a mutually convenient time for the initial meeting was set and participants were sent a consent form. These were collected before the first meeting began.

3.2.2. Co-creation process

To re-iterate, co-creation is *not* the active focus of the research, rather a means to an end; it was utilised as a tool to generate the most effective possible intervention through collaboration with expert practitioners. Therefore, consent was not sought to capture data as part of the process and the following is presented as a summary of notes made by the researcher to provide the reader with an understanding of the reasoning behind decisions taken regarding the design of the Mindset Kit.

As described above, there are a limited number of fully comprehensive ‘how to’ guides on executing an effective co-creation process. This is especially pertinent within Psychology, as much of the literature has been produced from a business perspective (e.g. Ramaswamy & Gouillart, 2010) or health service perspective (e.g. Greenhalgh, Jackson, Shaw, & Janamian, 2016). Although a review by Lee et al. (2018) does present descriptions of a broad array of projects and processes, only one of these includes teachers and is an educational service development project as opposed to a social psychological intervention. Therefore, as there are no directly adoptable co-creation processes outlined in the literature it is necessary to describe the process utilised in the current research and the reasoning behind the decisions made.

Often co-creation processes require facilitators (usually researchers) to engage with partners as an initial stage in the process to build working relationships that will allow for honest, equal, and bilateral discussion and control throughout the design process (Greenhalgh et al., 2016; Pepler, 2016). However, in the current research this was not required as all participants already had these relationships. It is important to note that these relationships were already of the nature required for effective co-creation, being equal and allowing for bidirectional communication. This is because the Stoke Reads programme was founded on the principle of collaborative and equal working relationships – all members working together to improve the outcomes of all members (and their pupils). Thus, with clear description and 'ground rules' the current design process could be initiated effectively with minimal management in respect of developing, maintaining, and managing working relationships.

All members of the co-creation team had significant workloads which meant it was necessary to adopt a process which allowed individual members to contribute within the constraints of their current workloads. This was considered essential to ensure that the co-creation environment felt like a positive collaborative space in which individuals willingly engaged without feeling obliged to do so or felt overburdened by its inclusion on top of existing commitments (Heerten et al., 2009). Therefore, an expansive initial meeting was the first step in the process as this was the ‘easiest’ option for the team to commit to. This meeting would cover all the major design features of the Mindset Kit, its content, and agree a schedule of the subsequent activities. Furthermore, should the initial meeting fail to cover all the items required then further meetings could be scheduled.

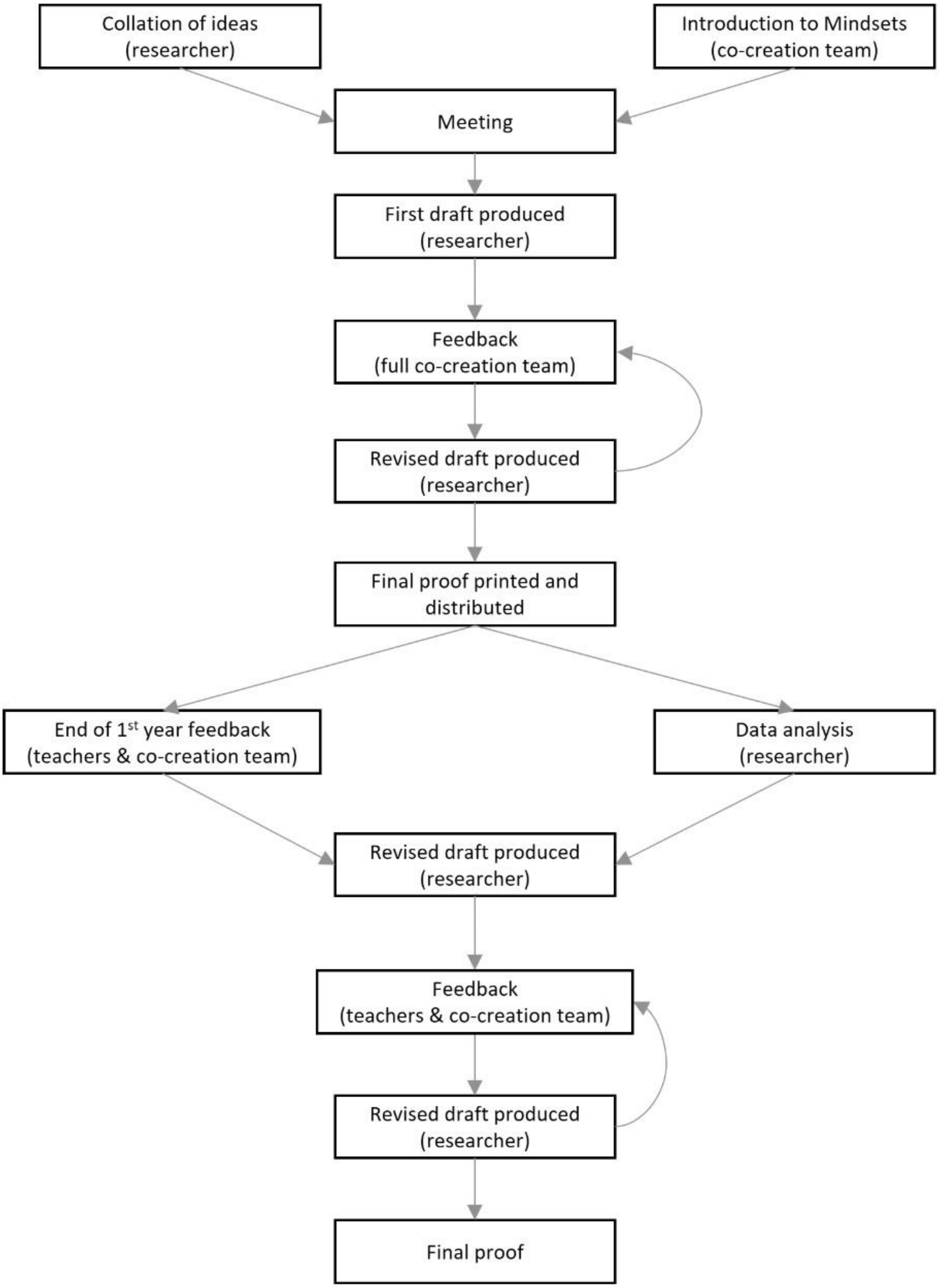

Figure 20. Intervention development process diagram

3.2.2.1. Initial meeting preparations.

Prior to the meeting, the researcher collated examples of all possible methods to promote growth mindsets (see Figure 20 for a process diagram). These were taken from the extant literature and from the internet, including blogs and discussions forums. The purpose of this bank of material was to provide examples to group members should a particular approach come up in discussion during the meeting. Group members with no prior knowledge of growth mindsets were directed to a website outlining mindsets (Popova, 2014). This website was chosen as it was highly accessible and covered a broad base of scenarios in which mindsets have been shown to hold influence: education, creative processes, self-perception, and relationships. It also briefly mentions neurological evidence for mindsets. These features were considered important as it demonstrates the fundamental nature of mindsets, with the intention of persuading teachers that it is not just an 'educational fad'. The group were also asked to consider their position on a range of questions before the first meeting, these were all interrelated but presented under headings:

- What format should the Mindset Kit take?
    - How long should it be?
    - Physical presentation – folder/booklet/website/etc.
    - Is the material and printing important? (e.g. glossy/regular printing)
- How do you create culture within your classroom?
    - Can you do this through activities?
    - Does the physical environment matter? E.g. displays
    - Your role as a teacher

- What about videos or training courses?
    - What makes training courses successful or meaningful for teachers?
    - Would training videos be a useful addition to the Mindset Kit?
- How do you think the Mindset Kit could best encourage teachers to promote a growth mindset culture in their classrooms, in the following two scenarios:
    - With unlimited resources
    - With very limited resources

3.2.2.2. The initial meeting.

The meeting began with a description of the project. This included an outline of the co-creation process and set out why it was important that the team were all equals in the project. This was reinforced by the researcher explaining that whilst he may have convened the group, that was merely a function of establishing it and in no way suggested any form of seniority or control. In addition, it was stated that in recognition of members workloads that the researcher's involvement would be to facilitate the production and subsequent revisions of the intervention. It was his role to produce the material the group decided to include in the Mindset Kit. It was found that only the researcher and supervisor had previously encountered the co-creation process. As such, it was important to ensure that all parties understood the equal power balance within the relationship, and they were all actively involved in the design process. This was reinforced at every available opportunity throughout the process, for example in subsequent emails amongst the group.

The primary objective of the meeting was to agree the format of the Mindset Kit and whether it should include any other support such as video training. It was important to reach a consensus upon this first as it would dictate the size of the kit. In turn, this influenced the style of activities which could be included in the Mindset Kit. There were several different positions advocated by members, from A4 ring binders with dividers and pull-out sections, to a preference for the least amount of material possible. This discussion also included the printing style (e.g. professional glossy or regular office laser printing), and the level of colouration in the Mindset Kit. After much discussion the group agreed on a few key points regarding the physical design of the Mindset Kit, outlined below.

Many decisions surrounding the physical formatting came from the desire of the group that the Mindset Kit be distinctive. Many of the group suggested that teachers are often saturated by A4 sized, black and white, instructions, memoranda, etc. Therefore, the group agreed that the Mindset Kit must not be A4 and try and be of a 'distinctive' shape and colour scheme whilst maintaining a professional look. This was counter to some initial preferences for an A4 style ring-binder which would allow for a very detailed intervention and still have room for teachers to include their own materials or notes. However, the argument that a smaller and distinctive Mindset Kit could be easily transported was accepted. Ease of transport was highlighted as a potential driver for engagement with some teachers who often do 'reading' at home and would avoid taking a potentially weighty A4 ring-binder home or may leave it at home and not access it whilst on school premises. A vibrant colour scheme was unanimously agreed upon as it may catch the eye, and whilst this may not prompt teachers to re-read the Mindset Kit, it may encourage or remind them to ensure they are promoting growth mindsets in their classrooms. Thus, meeting design criteria 4 (A 'minimal resource' approach) and design criteria 5 (Continued engagement from teachers).

Following the decision regarding the formatting of the Mindset Kit, the discussion moved on to content and whether training should be required for teachers engaged in the intervention. Initially members of the group discussed training that they had found most effective. The consensus was that training which provided teachers with tools and knowledge but allowed them freedom to integrate them into their own practice were the most well received amongst teachers. At this point the researcher put it to the group that it would not be possible to ensure that training was always available for the Mindset Kit unless it was online videos, owing to resource constraints. The teachers suggested that whilst videos may be a solution, teachers would likely view videos negatively as they would require planning or personal time to view. This is as opposed to a dedicated off-site training course which would likely be accounted for by their school management in their workload. The agreed solution was for the Mindset Kit to be highly accessible and to ideally not require training to be utilised by teachers. This decision eliminated design criteria 7 (Train the trainer model), but in doing so made design criteria 2 (Provide appropriate guidance/teacher endorsement) even more prescient. However, this did ensure we were meeting design criteria 3 (A 'legacy' product).

The point of teachers responding most positively to interventions which allowed them autonomy in their implementation was raised again. It was unanimously agreed that it is important to develop an intervention that teachers could select elements from with no minimum requirement to be effective. In doing so, they would feel empowered by the Mindset Kit rather and obliged to implement it. One teacher suggested that in their personal practice they would appreciate mindset ‘lessons’ as this would be a more ‘guaranteed’ way to promote growth mindsets effectively. However, after some discussion the argument of how a changing national curriculum could potentially render sections of the Mindset Kit irrelevant gained the most traction. Other members also cautioned that this was too prescriptive, and despite teachers being free to implement some, but not all, elements of the Mindset Kit having lessons plans could put teachers off any level of engagement. As this would feel like the intervention was ‘teaching them how to teach’. Despite some arguments to the contrary, to ensure an empowering as opposed to prescriptive feel it was agreed to not include any lesson plans. The group wished to explore how content which was not subject specific could be included. This removed design consideration 6 (Lesson plans).

An agreement was reached on how much theoretical content to include, it was decided that there must be no more than 5 pages and ideally include some of the concepts as images. The agreed goal was that teachers would be able to read the Mindset Kit and gain a practically useful understanding of the theory underpinning the intervention. The group agreed that it was critical to provide a foundational understanding of theory without overwhelming teachers. They suggested that the detail offered in the website they were directed to by the researcher was too expansive. The researcher suggested attempting to make all theoretical content as ‘real world’ as possible. For example, that descriptions of behaviours associated with a growth or fixed mindset would be presented as a vignette of a 'pupil'. All agreed that is important to present sufficient theory without it being too dry as users of the Mindset Kit would have limited interest in the mechanics of the theory underlying it.

Finally, a selection of potential activities, and approaches to promoting growth mindsets were presented by the researcher. The group unanimously accepted process praise as a method that teachers would be willing to utilise in their practice. One teacher proposed a growth mindset 'display' which they had seen in a school, one side listing fixed mindset 'thinking' and the other offering growth mindset 'alternatives'. The researcher presented to group the concept of promoting growth mindsets through 'stealthy' interventions which do not explicitly 'teach' growth mindsets but rather create a culture (e.g. Walton, 2014; Yeager & Walton, 2011). This avoided concerns that should growth mindset behaviours be presented as explicit and 'desirable', those pupils who were not displaying these behaviours could be criticised.

The group discussed ways of integrating growth mindset concepts or structures to lessons. This resulted in the following: books with growth mindset messages (i.e. perseverance and acceptance of mistakes as a learning process), famous figures who have growth mindset quotes attributable to them, and the use of token reward systems. The researcher presented the concept of a 'practice' lesson in which pupils would repeatedly work on a single task, week in week out, over a half or full-term. Teachers said that they felt this was an even bigger ask than mindset lessons. Whilst it would be robust to changes in the National Curriculum the time required was too great. The group collectively decided that the session would still be effective if done in shorter time periods, for example at beginning of the day during registration. This discussion then moved onto the consideration of utilising display spaces within the classroom to promote growth mindsets. The agreement was that highlighting the progress that pupils made towards a ‘final’ piece of work as opposed to the traditional display which would only present the ‘final’ work. Finally, both teachers stated that they often share best practice and ask questions of peers through social media, specifically Facebook. It was agreed to setup a Facebook group as part of the Mindset Kit.

3.2.2.3. Iterative process.

Following the generation of ideas and the group’s clear coalescence around a particular ‘feel’ of intervention the researchers produced the first draft of the Mindset Kit. The initial meeting concluded with members stating that their preference was to engage in this stage of the process via regular electronic communication, and that should it be required were happy to call another meeting. During this process a suggestion was put forward that there are many useful videos available on YouTube and other online video hosting sites that have growth mindset messages. Members agreed that this was a useful inclusion as teachers often utilise videos during their practice, or whilst pupils are completing other activities. This process continued through seven iterations, however this was not a linear process. The ‘core’ group, which were present for the initial meeting were engaged with every single iteration of the Mindset Kit. However, the other academic only felt able to review the 6th iteration as opposed to engaging with the full co-creation process. The other professionals from the Stoke Reads group engaged with different iterations as the project progressed.

3.3. Results

The full process resulted in the following elements being included and developed in the Mindset Kit. These are presented below in very brief detail as the full Mindset Kit is available in Appendix M.

- Introduction – 1 page – Provides a brief introduction and a pictorial representation of mindset behaviours
- Impact on learning – 1 page – This describes, in a vignette style, pupils with a growth or fixed mindset and how mindsets are dynamic and can be changed
- A growth mindset – 1 page – Puts forwards the four key elements of a mindset (theory of intelligence, application of effort, response to failure, and learning goals)
- How do I do this? – 1 page – Highlights important caveats and that the Mindset Kit is not prescriptive and that teachers should only include elements that they feel comfortable with
- Verbal feedback – 2 pages – This explains the different between person and process praise and why the two types of feedback influence mindsets
- It's everywhere – 1 page – This suggests popular movies and television programmes that contain growth mindset messages
- Music – 1 page – This exemplifies how music lessons can be a great resource for demonstrating progress that pupils have made

- Mindset books – 2 pages – A list of 6 books with growth mindset stories and questions that teachers may want to ask to prompt discussions around the growth mindset behaviours characters demonstrated
- Focussed practice – 2 pages – Setting out how you may configure a series of repeated practice sessions on particular tasks with pupils so they can see how their skills have developed over the period
- Class Dojo – 2 pages – Advice on utilising a free-of-charge token reward system with pupils to promote growth mindset behaviours
- Written feedback – 1 page – Examples of process praise teachers could offer, but in the written form
- Progress display – 1 page – Suggestions about how to celebrate pupils growth when producing classroom displays
- Successful people – 2 pages – A list of 6 famous (or historically important) people who have made growth mindset statements
- Mindset videos – 1 page – Suggested videos available on the internet which offer growth mindset messages
- Facebook group – 1 page – The internet address for the Stoke Reads Mindset Kit Facebook group

A secondary outcome of the process was a revised list of design considerations, which are important to list so it is possible to evaluate the Mindset Kit against these objectives. They are as follows:

1. Generate a classroom culture
2. Provide appropriate guidance/teacher endorsement
3. A 'legacy' product

4. A ‘minimal resource’ approach
5. Continued engagement from teachers

3.4. Conclusion

This chapter set out the design process of the Stoke Reads Mindset Kit. We believe that the co-creation which took place was highly effective as it produced an intervention which benefitted from the many perspectives involved in its production. Importantly, the design process also met all of the revised design criteria. Through the iterative feedback process, the level and quantity of theoretical content was refined and the teachers in the group agreed that it met design criteria 2 (provide appropriate guidance/teacher endorsement). The Mindset Kit requires no resources or training for teachers to be able to utilise it, therefore meeting both design criteria 3 (a ‘legacy’ product) and 4 (a ‘minimal resource’ approach). Finally, it is important to highlight that funding was secured to print the Mindset Kit professionally, in a glossy style. The final agreed format for printing was 21cm x 21cm which with a vibrant blue colour scheme and bespoke graphics, thus helping the Mindset Kit meet design criteria 5 (continued engagement from teachers). By allowing the Mindset Kit to stand out on teachers’ desks or shelves. It further met this criteria by the inclusion of a Facebook group and the Mindset Kit being free to download from the internet.

The co-creation process adopted in the current research is not as expansive as often described in the literature (Heerten et al., 2009). By engaging busy professionals to the extent that they were able to commit, there was not room in the process for expansive, exploratory workshops to define the problem and remit of the design process (Bailey et al., 2019). Much of the current creative process was focussed on the initial meeting. However, extensive exploratory workshops were not essential to the current research project as the problem was already clearly defined ("how to enable teachers to promote growth mindsets"). The a priori development and specification by funders of some of the design considerations further helped to guide the discussion and development.

As discussed in this and other chapters, teachers have very high workload demands (National Union of Teachers, 2014). Therefore, they are unable to commit a large amount of time to an expansive design process. The current process managed to successfully produce a model which allowed co-creation to take place with no resources (other than time), and between a team who had very limited time to offer. Within the Sanders and Stappers (2014) model, the generative element was the initial meeting and the evaluative stage was the iterative part of the process. Despite not adopting 'design thinking' (as per Yeager et al., 2016) the iterative process is somewhat similar to the process which they describe. With a 'minimally viable' product being presented to the group for feedback at the various stages of the process.

In summary, the process developed in the current research provided an effective means to develop the Stoke Reads Mindset Kit. Much research which employs a collaborative design process *for* a group designed to enact change often describes the importance of generating and managing relationships within the research process (e.g. Greenhalgh et al., 2016; Phipps, Cummings, Pepler, Craig, & Cardinal, 2016). The team which developed the Stoke Reads Mindset Kit already had positive and professional relationships but had very limited resources with which to supply the process. Importantly a clear structure, defined roles and ‘culture’ within the co-creation team, are critical to success in such endeavours.

4. Intervention Evaluation - Pupils

4.1 Introduction

This chapter describes the findings of the evaluation of the Stoke Reads Mindset Kit, focussing on the results from pupils. To begin it explores how existing evaluations of mindset interventions have been conducted. This critical review informed the approach taken in the current evaluation and considerations regarding analysing data from young children are also discussed. An exposition of the data analysis strategy follows; this same underlying approach is also utilised in the subsequent two chapters. Chapter 2 outlined the development of the instrument used to capture pupil's mindsets, therefore only the Phonics and Early Reading Assessment (PERA) will be covered in detail. In the interests of clarity, each research question will be addressed with the analyses performed to address them. As the three research questions in this chapter are all logically related a short general discussion concludes the chapter.

There is a great desire within the field of educational research to develop interventions which can be effectively scaled up (Wilson & Buttrick, 2016). In developing interventions at scale, researchers are often concerned with their fidelity when employed in the 'real world' (Gearing et al., 2011). How much the individual delivering the intervention follows the prescribed instructions of the intervention can have significant influences on the outcomes of the intervention (Mendive, Weiland, Yoshikawa, & Snow, 2016). Many interventions designed to promote growth mindsets have opted to remove a facilitator and provide computer-based materials to pupils (for example Mindset Works Inc., 2008; Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018; Yeager et al., 2016). These are arguably high-fidelity interventions; pupils log onto a website or use software which requires no input from a facilitator bar the use of a computer. The cost per-pupil of such interventions is comparatively low at around $0.20 per pupil (The World Bank, 2017). These interventions are delivered directly to pupils are of short duration (often circa one hour) and show promising signs for the potential of growth mindsets to develop pupils' educational potential (Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018). However, these interventions do not account for any other influences on the pupil, such as teachers, school culture, or peers.

Failing to account for other influences on mindsets is problematic. There is some evidence which suggests that growth mindsets promoted by computer-based interventions may fade over time (Donohoe, Topping, & Hannah, 2012). This study investigated the 'Brainology' programme, developed by Dweck and Blackwell (Mindset Works Inc., 2008) which promotes growth mindsets through gamified maths activities. The games and lessons focus on delivering mindset messages, such as how the brain forms synaptic connections. The activities require players to reflect on applying the lessons to their own learning. In Donohoe et al. (2012) they measured the impact of this intervention. Pre-test and post-tests were completed one week after the programme and follow-up tests were completed three months following the completion of the programme. Donohoe et al. (2012) reported evidence that supports a notable change in pupil's mindset towards a growth mindset orientation between the pre and post-test. However, follow-up data suggested that participants' mindsets had returned to levels comparable to the pre-test. A further longitudinal observational study also found that interventions can change mindsets over time in college students. This study captured their mindsets at four time points over a twelve-month period (Dai & Cromley, 2014). The study was configured similarly to that of Donohoe et al. (2012), with a pre-test (1 week prior to intervention), post-test (3 weeks after), and follow-up test (2 months following post). Orosz, Péter-Szarka, Bőthe, Tóth-Király, and Berger (2017) reported follow-up scores which returned to level similar to pre-test in a sample of 55 students aged between 15 and 18 years.

Such reports of fluctuations in mindset are to be expected; there is a significant body of work demonstrating how easily individual's mindsets are influenced. For example, the use of subtle differences in language can promote growth mindsets (Henderlong & Lepper, 2002; Skipper & Douglas, 2012; Zentall & Morris, 2010). If mindsets are as sensitive as this evidence suggests, then a chance phrase from a teacher, parent, or friend could orientate pupils towards a different mindset. Yet there is contrary evidence, suggesting that mindsets appear to be stable over similar periods of time; Park, Gunderson, Tsukayama, Levine, and Beilock (2016) report a 0.29 point (out of 30 points) change over one school year in a sample of six to eight-year-olds. Overall the limited evidence base and the conflicting findings concerning the stability of mindsets over time make it challenging to draw firm conclusions regarding how stable young children's mindsets are. Considering how sensitive mindsets are to stimuli which may change them it would seem appropriate to provide an environment which promotes growth mindsets. The Stoke Reads Mindset Kit attempts to do this; it aims to enable teachers to adapt their existing pedagogical practices to create learning environments which promote growth mindsets. These environments will ensure pupils are spending a substantial amount of time in a space which promote growth mindsets, therefore buffering them somewhat against fixed mindset messages from the other areas of their life.

Many mindset interventions have adopted a pre-post strategy in their evaluation. This means that data are collected from participants prior to the intervention beginning and again once the intervention has concluded (Robson & McCartan, 2015). As many mindset-based interventions are focussed on improving educational outcomes, pre and post tests are often completed at the beginning and end of a school year. Often data is quantitative, and mindsets are captured via survey methodology. It is usual, as most interventions are produced and evaluated in the United States, that educational outcomes are measured via changes in Grade Point Average (GPA) scores (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Sisk et al., 2018). Within the current research a quantiative approach will also be adopted, using a pre-post set of configuration.

4.1.1. Pupils at risk of under achievement

Previous research suggests that growth mindsets are most beneficial to pupils at risk of educational underperformance, for example those from lower socioeconomic backgrounds (Claro, Paunesku, & Dweck, 2016), or those who are on a negative learning trajectory (Blackwell, Trzesniewski, & Dweck, 2007). There are different categories of pupils who may be at risk of academic underperformance which will be assessed in the current research: male pupils, pupils with special educational needs or disabilities, and those who speak

English as an additional language. The definitions of these categories and how a growth mindset may help them will be set out below.

Research has consistently shown that boys do not perform as well as girls across most subjects during schooling, but they fall particularly behind in reading (Clark & Burke, 2012). The report produced by Clark and Burke (2012) was written as part of a UK Government Commission to address boys' poor reading achievement held during 2012. However, despite such work boys still lag behind their female peers during the early years as demonstrated in the most recent Key Stage 1 results (Department for Education, 2019). Research has shown that even in the early years, boys are likely to understand the nature of gendered roles, and therefore associate their lower performance with their gender (Patterson, 2012). Such negative associations and performance on reading has been associated with negative classroom behaviours, resulting in teacher frustration or reprimands, further contributing towards boys negative reading experience (Garwood, Varghese, & Vernon-Feagans, 2017). Additionally, this will likely build a negative stereotype around boys reading. Thus, it could be argued that boys struggling to read are liable to exposure to stereotype threat. Stereotype threat occurs when individuals are or feel themselves to be at risk of conforming to stereotypes about their group. A growth mindset helps reduce this by allowing pupils to see the object of the stereotype, in this case intelligence as malleable and therefore maintain engagement with learning (Aronson, Fied, & Good, 2002). Thus, if boys have a growth mindset, they may believe the stereotype that boys are less intelligent than girls, but may believe that they can improve their intelligence, thus reducing the negative impact of this stereotype.

In the UK, pupils who have special educational needs or disabilities which can affect their ability to learn may receive extra support (GOV.UK, 2019). Pupils who struggle with their behaviour or ability to socialise, reading and writing, ability to understand things, ability to concentrate, or physical ability are most likely to receive assistance. The support is often formalised into two main categories, informal support from their school or an education, health, and care plan (EHC). The latter is often provided for pupils who have more complex needs (GOV.UK, 2018). Despite such support mechanisms pupils with special educational needs or disabilities often perform below their peers (Department for Education, 2017b). These pupils are likely to be aware of their additional needs and feel negatively about them, making them sensitive to negative stereotypes. As above, a growth mindset has been shown to help pupils overcome stereotype threat and therefore enhance their performance (Shapiro, Aronson, & McGlone, 2015).

Pupils may speak English as an additional language (EAL), these pupils' academic results have historically been behind their peers (Farrell, Dyson, Polat, Hutcheson, & Gallannaugh, 2007; Strand, Malmberg, & Hall, 2015b). However, this gap is slowly closing for pupils with EAL but can vary between schools, particularly for primary school pupils (Department for Education, 2017a; Strand et al., 2015b). Research does suggest that learners who speak English as an additional language may flourish in school. But they may also encounter fewer positive environments, such as school environments that are unable to offer them additional support to develop their English skills and that their educational experience is not consistent across schools (Flynn, 2013; Foster & Groves, 2004).

They are likely to be stereotyped by both their teachers and peers as less able (Campbell, 2013). As with SEND pupils this exposes them to stereotype threat which may inhibit their academic performance but may be alleviated by a growth mindset (Aronon, Fried, & Good, 2002).

Research has shown that pupils are aware of differences in achievement between them and their peers and indeed, the very act of providing support to certain pupils identifies and labels their differences. In highlighting these differences, particularly within mainstream schools, pupils may feel negative about their difficulties and often have negative self-images, often as a result of stereotypes (Kelly & Norwich, 2004). Stereotype threat theory proposes that when there is a negative stereotype about a group to which an individual belongs (e.g. "boys are bad at reading") and they become concerned about being judged based upon this stereotype. This can lead to the individual either conforming the norms of the stereotype or performing poorly as a result of the extra pressure (Shapiro, Aronson, & McGlone, 2015). Growth mindsets have been shown to help learners overcome stereotype threat because the understanding that their intelligence can be developed as provided by a growth mindset allows them to overcome the limitations they impose upon themselves derived from the stereotype (Aronson, Fried, & Good, 2002; Aronson et al., 1999). In the current research, growth mindsets may help the pupils in the above categories achieve their potential by overcoming stereotype threat. Having a growth mindset means that they will understand their intelligence as malleable. This will invalidate the negative stereotype of lower intelligence associated with their group and help them to achieve their full potential (Yeager, Walton, et al., 2016).

Whilst there is growing body of research showing that groups at risk of academic under performance benefit the most from a growth mindset, there is a lack of work investigating whether different groups are more or less receptive to growth mindset messages. For example, pupils from Germany were more likely to understand intelligence as fixed compared to pupils from the United States (Kurtz-Costes, McCall, Kinlaw, Wiesen, & Joyner, 2005). A recent meta-analysis found a stronger association between growth mindsets and achievement for pupils from Asia and Oceania (Costa & Faria, 2018). Whilst such work has not addressed whether individuals may respond different to growth mindset messages it does highlight that there are elements which may need to be accounted for. Therefore, the current research will address how receptive pupils were to the Mindset Kit based upon their gender, if they have SEND, or EAL.

4.1.2. Analytical approach

When analysing data which contain multiple groups, for example, the current research data are from children who are grouped in schools, it is important to recognise this structure in any analyses. This is important because the data from each class are likely to be correlated (or homogenous) (Peugh, 2010). Homogeneity in data from classrooms occurs because the pupils within classrooms are being taught by a particular teacher, whose teaching style, personality, and other factors influence the children within their class in a similar way. This is particularly relevant in the current research as the teachers facilitated the intervention, which whilst not prescriptive, contains activities which are designed to generate growth mindsets and each teacher's interpretation of the intervention may potentially be different. Furthermore, data have been collected at both pre and post-test from pupils, it is also likely that an individual will respond to instruments homogenous fashion over the two time points. This means that it is likely there will be homogeneity of variance at the classroom and pupil level which must be recognised within analyses. The hierarchical structure of the current data must also be recognised in analyses. Failure to do so can mean that up to 90% of individual variability on the outcome variable can be lost, leading to significant over or under estimation of the relationship between variables (Snijders & Bosker, 2012).

The most appropriate analysis strategy is multi-level modelling, random effects modelling, or hierarchical linear modelling; these all refer to the same type of regression-based analysis. Within this thesis it will be referred to as multi-level modelling as this best reflects the purpose for which it is being used. Multi-level modelling accounts for the intra-class correlation (ICC) of the grouped nature of data from pupils within classrooms or schools (Gelman & Hill, 2007). Currently, one of the most flexible software packages available to complete such analyses is BRMS within the R programming language (R Core Team, 2016). BRMS is a specialist package designed to compute models which may be multi-level, multi-variate, and non-linear within the Bayesian framework (Bürkner, 2017b). Within the current research the Bayesian framework and some features of the BRMS package are advantageous for several reasons. Firstly, the Bayesian framework does not require data to adhere to the assumptions within the frequentist framework; as is shown later, the current data do not support these assumptions (Dunson, 2001; Maas & Hox, 2004). The BRMS package also allows non-gaussian distributions to be accurately modelled using a variety of methods, which will be discussed later.

Multi-level models are built using an iterative process requiring comparison between models as different aspects of the model are investigated (Gelman & Hill, 2007; Peugh, 2010). The goal is to find a model which neither under nor over-fits the data, and methods used to provide information about the fit perform a trade-off between complexity and accuracy of description. To compare the models an information criterion is used; in the current research the leave-one-out cross-validation (LOO) will be used. This process removes part of the data, fits the model to data without the removed section, uses these data to predict the previously removed portion, and computes prediction error by comparing to the removed section (Vehtari, Gelman, & Gabry, 2017). The goal of this approach is to reduce deviation from zero, therefore smaller values are favoured. For example, if negative LOO-IC values are found, e.g. -100 and -200, then -100 would be preferred. When comparing models, the difference in LOO value can be considered informative should it be greater than the standard error produced (Bürkner, 2017a; Vehtari et al., 2017).

When working in the Bayesian framework, samples for posterior probabilities are generated at random within the parameters of the distribution. To ensure reproducibility and consistency of outcomes the ‘seed’ will be set to the same across all models. These seed numbers feed the sampling algorithm which iteratively draws samples for each parameter within the posterior distributions and compares these to assess if they are a better approximation of the target (informed by the prior) posterior distribution (Gelman & Hill, 2007; Kruschke, 2015; McElreath, 2016). This process will be set to occur 2000 times for each model, unless otherwise specified. As these samples become more homogenous, within tolerance, the model is said to have converged (Gelman & Hill, 2007). The outputs from BRMS include two main methods for assessing model convergence. Firstly, a numerical quantifier 'RHat', which must be below 1.1 for the parameter within the model to have converged. Secondly, a graphical trace of the parameters estimation, which should produce a cohesive trace (Bürkner, 2017b; Gelman & Hill, 2007; Vehtari et al., 2017). Both will be assessed for each model and only discussed if they suggest the model has failed to converge.

In the Bayesian approach the confidence interval is not used, the alternative is known as the credible interval. They can produce mathematically similar results; however, they are philosophically quite different (Kruschke, 2015). Within the Bayesian framework probability is a measure of the degree of certainty about values (Feinberg & Gonzalez, 2012). Therefore, data are considered fixed and model parameters to be random, thus the credible interval is interpretable as 'given data, there is a 95% probability that the true mean falls within the interval'. Within the frequentist framework probability is a measure of the frequency of repeated events. Therefore, the assumption is that data is random and model parameters are fixed and the confidence interval can be understood as meaning 'there is a 95% probability that the true mean will fall within the interval given this sort of data'. The credible interval considers the probability of the parameter value given fixed bounds. Yet the frequentist confidence interval is the probability about the bounds given a fixed parameter value (Wagenmakers et al., 2018). As the subsequent analyses in this chapter will be completed within the Bayesian framework these definitions are included to aid the interpretability of the outputs.

The coding of the MMYC Question 7 (occupational aspiration) produces ordinal data. There are nine potential categories in which the free text response could have been coded and it cannot be assumed that the increments between categories are the same. There are increased risks of both Type I (detecting an effect when none exists) and Type II (failure to detect and effect when one exists) in analysing ordinal data as though they were metric (Liddell & Kruschke, 2018). It is more appropriate to utilise an ordered-probit model as this is more likely to describe the data more accurately. Within BRMS the cumulative model is available and will be used throughout this chapter as all outcome variables are ordinal (Bürkner & Vuorre, 2018).

4.1.3. Research Questions

This chapter will address three separate research questions:

1. Did the intervention change mindsets?
    a. A general perspective – how effective was the Mindset Kit at promoting growth mindsets across the whole sample?
    b. Whether the mindsets of groups at risk of academic underperformance were more or less impacted by the intervention
2. Are mindsets related to academic performance?
    a. A general perspective – was there an association between academic performance and mindset across the whole sample

b. Did the groups at risk of academic underachievement benefit most from a growth mindset?

3. Did the intervention improve academic performance?

4.2. Method

4.2.1. Participants

Ethical approval was granted by Keele University (see Appendix L). Initially 443 pupils were recruited from nine primary schools in Staffordshire, United Kingdom. At Time 0, a total of 443 pupils were aged between 56 and 78 months (Mean = 65.69, Median = 65.00, SD = 3.61), with the sample consisting of 194 females and 191 males (some pupils were missing gender information), 52 or 11.74% of pupils were identified as having special educational needs (SEN), and 63 or 14.22% of pupils were identified as speaking English as an additional language (EAL). At Time 1, a total of 410 pupils were aged between 68 and 89 months (Mean = 76.34, Median = 76.00, SD = 3.58), with the sample consisting of 197 females and 194 males, 49 pupils were identified as having SEN (11.95%), and 35 as speaking EAL (8.54%). The change in the number of pupils with EAL between Time 0 and Time 1 could be attributed to the City of Stoke-on-Trent being known (anecdotally) to have a transient school population, the majority of which are children of families who do not speak English as their primary language.

4.2.2. Materials

4.2.2.1. Phonics and Early Reading Assessment

The Phonics and Early Reading Assessment (PERA) is produced by Hodder Education Ltd (McCarthy & Ruttle, 2012). PERA compromises two age standardised tests, one for phonics and one for sentence reading ability, and a reading comprehension test which is not age standardised. The two tests in the PERA are Test 1 and Test 2. Test 1 was designed to be used with children between 55 and 78 months of age for both phonics and sentence reading. Test 2 has an age range between 70 and 82 months of age for phonics and 70 and 94 months of age for sentence reading. The reading comprehension tests are completed in conjunction with the sentence reading elements and therefore the same age ranges apply. Age-standardised test scores provide information about where each pupil is in relation to their average peer of the same age (see Figure 21). Such standardisation is completed during the development of the test and distributions of scores were produced for each potential score, by each age in month for each test.

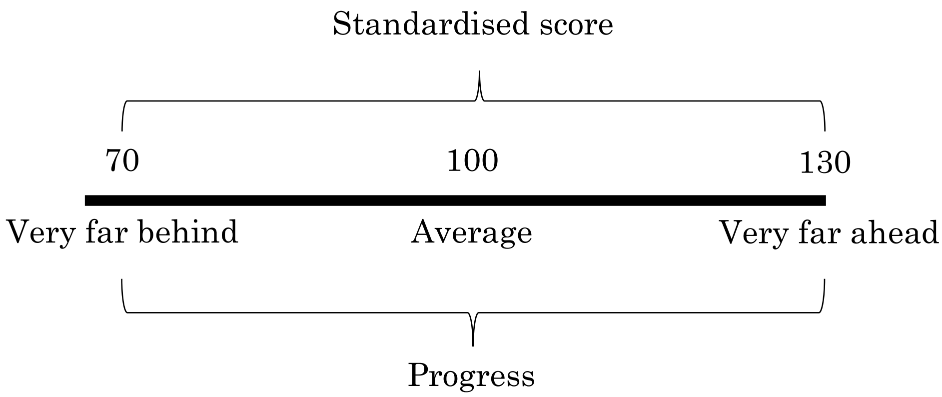

Figure 21. PERA score meanings.

Prior to the start of this research, the Stoke Reads group of schools already used PERA to collect phonics, reading, and comprehension data from their pupils at the end of Reception (age 4-5) and the end of Year 1 (age 5-6). This was undertaken by the group to allow evaluation of the Stoke Reads programme and as part of internal school assessments. As this research was situated within the Stoke Reads group this presented an excellent opportunity for the mindset instrument outlined in the previous chapter to be administered by schools as part of the existing PERA testing process. It was agreed by the Stoke Reads group that the behaviours contained within the instrument were of interest to the group and to schools individually, and therefore they unanimously opted to complete the additional tests. Upon recruitment to the current investigation schools were already completing both sets of tests and did not need to complete any additional tests.

Assessing progress made across a single academic year during the Early Years Foundation Stage and Key Stage 1 is challenging. This is primarily because of the comparatively small amount of information pupils in these year groups are expected to learn in one subject, the statutory requirements in the national curriculum for literacy in Key Stage 1 (Department for Education, 2013) are relatively narrow:

- Apply phonic knowledge and skills as the route to decode words
- Respond speedily with the correct sound to graphemes (letters or groups of letters) for all 40+ phonemes, including, where applicable, alternative sounds for graphemes

- Read accurately by blending sounds in unfamiliar words containing GPCs that have been taught
- Read common exception words, noting unusual correspondences between spelling and sound and where these occur in the word
- Read words containing taught GPCs and –s, –es, –ing, –ed, –er and –est endings
- Read other words of more than one syllable that contain taught GPCs
- Read words with contractions [for example, I'm, I'll, we'll], and understand that the apostrophe represents the omitted letter(s)
- Read aloud accurately books that are consistent with their developing phonic knowledge and that do not require them to use other strategies to work out words
- Re-read these books to build up their fluency and confidence in word reading

This therefore means that any tests of pupils' basic abilities must have a high resolution, meaning that they are sufficiently sensitive to be able to provide an accurate representation of pupils' development over the period (Miura Wayman, Wallace, Wiley, Tichá, & Espin, 2007). PERA offers such resolution, owing the narrow age bandings for the tests. Furthermore, the tests were developed to fit with the Letters and Sounds framework (Department for Education and Skills, 2007; McCarthy & Ruttle, 2012). The Letters and Sounds framework was the predecessor to the current national curriculum which maintains all the principles of teaching phonics but does not follow the same structure. This means that pupils' abilities to utilise phonics, read sentences, and comprehend the meaning of text that pupils will be expected to achieve during Reception and Year 1 remains the same. Therefore, PERA is an appropriate instrument to measure pupils' progress.

PERA provides three scores: phonics, sentence reading, and reading comprehension. PERA is administered on a one-on-one basis, using a set of cards which display the words and non-words and an assessment sheet on which the pupil's responses are recorded. The phonics part of the tests has three elements. The first asks pupils to read single words aloud, the second requires pupils to pronounce 'non-words', the final part tests a pupil's ability to identify a target word or non-word from a list which is read aloud by the test administrator. The sentence reading element also includes the comprehension test, pupils are asked to read a sentence and assuming they make 2 or less errors they are then asked a question which tests their comprehension of the sentence they just read. For examples of the materials please see Appendix N.

4.2.2.1. Mindset Measure for Young Children

As the Mindset Measure for Young Children (MMYC) is outlined in Chapter 2 and the full version is in Appendix F only minimal detail will be provided here as reminder to the reader as to which questions were which and what construct they measure:

1. Performance goal – "Let's say the things to do in this picture are really easy, you will probably get them all right, but you probably won't learn anything new. How would you feel about doing these?"

2. Learning goal – “Let’s say the things to do in this picture are really hard, you will probably get some of them wrong, but you will probably learn new things. How would you feel about doing these?”
3. Affective response to failure – “How do you feel about your drawing of the cat that you got wrong?”
4. Persistence following failure – “If you got the chance to draw one of these again, how would you feel about drawing the cat that you got wrong last time?”
5. Affective response to success – “How do you feel about your drawing of the house that you got right?”
6. Persistence following failure – “If you got the chance to draw one of these again, how would you feel about drawing the house that you got right last time?”
7. Occupational aspiration – “What do you want to be when you grow up?”
8. Essentialism – “Are some people born clever?”
9. Mindset – other – “Can they change how clever they are?”
10. Mindset – self – “Do you think that you can change how clever you are?”

Within this chapter Question 7 – occupational aspiration, will not be considered in the current chapter as the relationship between mindset and occupational aspiration is evaluated in Chapter 6.

4.2.3. Design

The evaluation of the intervention utilised a quasi-experimental design with an experimental and comparison group. It was decided to adopt a quasi-experimental design and not allocate schools randomly as the researcher was aware of how the schools had engaged with the Stoke Reads programme. Some schools had been highly receptive to 'outside' interventions, whereas others had been more reticent to change their practice. The small number of schools in the programme would have presented a significant risk when employing random allocation that no balance would have been achieved between schools who engage with external interventions well and those that were known to not engage as fully. For example, having an experimental condition with only schools receptive to interventions could have significantly skewed findings.

As highlighted by Gopalan, Rosinger, and Ahn (2020) a major threat to quasi-experimental designs is that the comparison (or control) groups are often comprised of groups or participants who have not, of their own volition, opted into the experimental condition. For example, in clinical settings a patient has not selected the treatment option. They suggest that this makes comparison groups more likely to have lower scores than experimental groups owing to their passivity. The allocation in the current design ameliorated this by placing schools into the intervention or control condition based upon the researcher's prior knowledge of their engagement with past interventions.

However, this is not the only potential issue with quasi-experimental designs. Firstly, and particularly within applied educational research, it is not possible to precisely define the opposite group to the experimental condition as the "control" group, even if there were an absence of any intervention, other factors will influence pupil achievement (Handley, Lyles, McCulloch, and Cattamanchi, 2018). This also applies to schools within the experimental condition of the current research, they had their own demographic features and internal practices in addition to the intervention which will have influenced pupil achievement. Therefore, it is important to recognise that within the current research there may have been unmeasured variability between experimental and comparison schools meaning the boundary between the two groups was not completely delineated. For example, one school was based in an economically deprived area of the city whereas one was based in one of the most affluent areas. It is well established that socioeconomic status is a predictor of educational attainment (Potter, 2007).

Whilst it is a positive feature overall that the current research took place over a full academic year, the advantages of which are discussed elsewhere, it is pertinent to recognise that this also potentially created an opportunity for cross-contamination between groups. It is very unlikely owing to geographical separation and the age of pupils that any cross-contamination occurred between these participants. Yet, it may have been possible, given the nature of the Stoke Reads Programme that teachers discussed the Stoke Reads Mindset Kit amongst themselves. However, every care was taken to encourage individual teachers not to do so and the development of the intervention was not a public 'feature' of the programme until after the evaluation had taken place to minimise the possibility of cross-contamination between teachers. Despite these efforts there it is not possible to rule out any cross contamination or possible to robustly delineate the comparison and experimental groups. This must be taken into account when considered the results of the following evaluation.

4.2.4. Procedure

4.2.4.1. Consent

Ethical approval was gained from Keele University before any contact was made with any schools, parents, or pupils, please see Appendix K**.** Initially head teachers were contacted via letter to request their permission for the study to take place in their school and their *loco parentis* consent for the pupils to participate in the study (see Appendix O). Once this had been obtained parents were then contacted directly via letters sent home with pupils, these were of an opt-out format, meaning that parents had to return a slip to school before a specified date should they not wish their child to participate (see Appendix P). Two copies of the letter were sent home, one week apart, to ensure that parents received the letter should their child have been absent from school on the day the letters were sent home.

4.2.4.2. Data collection

Assessments were completed at two time points. Testing at Time 0 took place between June 2016 and July 2016. Testing at Time 1 took place between June 2017 and July 2017. The PERA and MMYC were administered one-on-one with pupils in a quiet space outside of their main classroom area. Testing was completed by teachers or teaching assistants. Apart from one school at post-test all MMYC data were collected by teachers in schools. This one school did not have enough capacity to complete the MMYC. In this instance a team of researchers from Keele University completed the testing.

Both PERA and MMYC provided included detailed instructions for administrators which included a script and instructions about when to show materials (see Appendix G for MMYC and Appendix N for PERA).

4.2.4.3. Data anonymisation

Data were anonymised by Stoke Reads before being passed to the author. Stoke Reads produced a database with pupil names, and other demographic information (i.e. date of birth, EAL, gender, etc.), alongside an anonymous code. An anonymised copy was provided to the researcher. Schools identified each pupil on testing materials with their anonymous code.

4.2.4.4. Data preparation

Data from paper forms were inputted into Microsoft Excel by the researcher and a research assistant. Input errors were checked for by sorting the data, conditional formatting, and visual inspection of histograms. Both researcher and assistant checked complete copies of the data set and compared errors before mutually agreeing corrections. Several anomalies were detected in the Time 0 data after inputting was completed. The forms require the test administrator to add up several scores, and to match these scores on a table to find the standardised score. To ensure accuracy, only raw scores were inputted into the dataset and R code was written to compute the standardised scores and age at testing.

As PERA requires scores to be collected from a standardisation matrix, some pupil's scores were unable to be standardised because they scored too high or too low for their age, i.e. the test can have ceiling or floor effects. To understand how the ceiling or floor effects influence data they were assessed to see how many pupils who completed the assessment were unable to gain a standardised score. For phonics, 4 pupils scored below and 54 scored above, which is 8% of the total cases. For reading, 14 scored below and 40 scored above, which is also 8% of cases. This is a reasonable proportion of overall data and suggests ceiling and floor effects of PERA within the current sample. As can be seen from Figure 22, the standardisation matrix is not a linear relationship between age and score, making it complex to assign meaningful scores to cases which suffered from the ceiling and floor effects. Therefore, these cases were given a score a single point lower or higher than the relative minimum and maximum scores, 68 and 131 respectively. Analyses were conducted including and excluding these cases, no substantial differences were found so data were included.

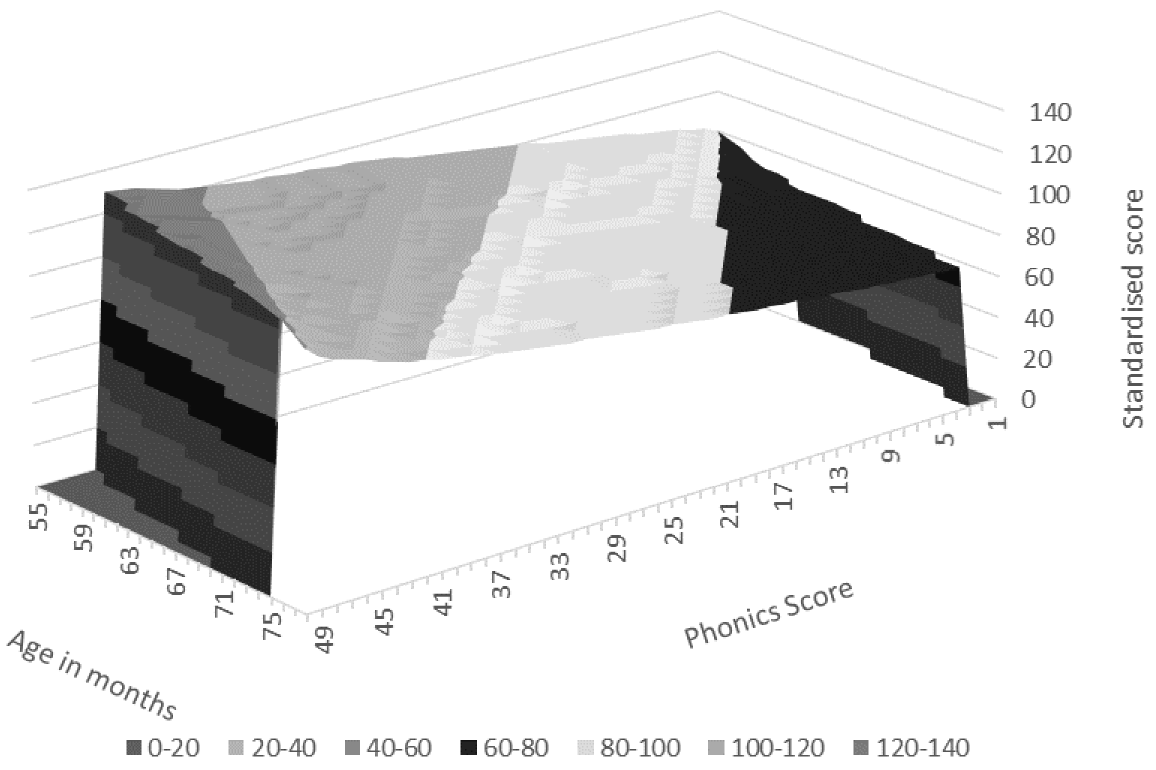

Figure 22. 3D surface area graph of the phonics standardisation matrix.

4.3. Results - General

The results below are of the analyses addressing the following research questions:

1. Did the intervention change mindsets?
2. Are mindsets related to achievement?
3. Does the intervention improve achievement?

Many of the descriptive statistics are relevant to all of the research questions, to avoid repetition they are grouped below for all research questions. The following analyses are performed using BRMS (Bürkner, 2017b), the models are written out in plain language below for ease of communication. The models in full and the R code are presented in Appendix C.

Table 23 shows the descriptive statistics for Questions 1 through 7 of the MMYC in subsets by time and by condition. Table 2 shows the descriptive statistics for Questions 8 through 10 of the MMYC in subsets by time and by conditions. The two groups of questions are separated as the dichotomous response format of Question 8 through 10 makes it necessary to report different statistics. As discussed in previous chapters these must be treated as individual items and not as a single latent variable representing pupils' mindsets. Descriptive statistics of PERA data is contained in Table 24. In all tables the abbreviation "Exp" refers to experimental condition, "Comp" to comparison condition, and Low/High 95% CI refers to Low/High Credible Intervals.

Table 22.
Descriptive statistics for MMYC data - Questions 1-7 by time and condition.

	Q	Condition	Time 1 Mean	SD	Low 95% CI	High 95% CI	Time 2 Mean	SD	Low 95% CI	High 95% CI
Performance Goal	1	Comp	2.11	1.53	1.90	2.33	2.62	1.67	2.38	2.86
		Exp	2.29	1.77	2.05	2.52	2.62	1.79	2.35	2.89
Learning Goal	2	Comp	2.83	1.68	2.60	3.07	3.13	1.55	2.90	3.35
		Exp	3.80	1.90	3.55	4.05	3.08	1.75	2.81	3.35
Failure – Affect	3	Comp	4.09	1.52	3.87	4.30	3.79	1.47	3.57	4.00
		Exp	4.16	1.62	3.94	4.37	4.04	1.54	3.81	4.28
Failure – Persistence	4	Comp	2.54	1.66	2.31	2.77	2.39	1.59	2.16	2.62
		Exp	2.41	1.72	2.18	2.64	2.04	1.49	1.81	2.27
Success – Affect	5	Comp	1.60	0.93	1.46	1.73	1.59	1.22	1.42	1.77
		Exp	1.52	1.05	1.38	1.66	1.85	1.53	1.61	2.08
Success – Persistence	6	Comp	2.26	1.47	2.05	2.46	2.54	1.71	2.29	2.79
		Exp	2.60	1.88	2.35	2.85	3.25	1.80	2.98	3.53
Aspiration	7	Comp	5.72	3.79	5.19	6.26	4.05	3.24	3.58	4.52
		Exp	5.48	3.84	4.97	5.99	4.29	3.15	3.80	4.77

Table 23
Descriptive statistics for MMYC data - Questions 8-10 by time and condition.

	Q	Condition	Time 1 Responded Yes (%)	Time 1 Responded Yes (N)	Time 2 Responded Yes (%)	Time 2 Responded Yes (N)
Essentialism	8	Comp	62.69	126	66.83	139
		Exp	64.46	156	61.39	124
Mindset – Others	9	Comp	49.75	100	68.27	142
		Exp	71.07	172	68.81	139
Mindset - Self	10	Comp	77.11	155	84.14	175
		Exp	80.58	195	81.19	164

Table 24.
Descriptive statistics of PERA data by time and condition.

	Condition	Time 1 Mean	Time 1 SD	Time 1 Low 95% CI	Time 1 High 95% CI	Time 2 Mean	Time 2 SD	Time 2 Low 95% CI	Time 2 High 95% CI	Mean difference
Phonics	Comp	105.15	14.39	103.04	107.27	107.10	13.90	105.09	109.12	1.95
	Exp	108.18	16.19	106.00	110.36	109.39	12.64	107.45	111.33	1.21
Reading	Comp	105.96	13.13	104.04	107.88	103.80	12.67	101.88	105.72	-2.16
	Exp	107.38	16.56	105.19	109.57	105.72	10.48	104.05	107.38	-1.66
Comprehension	Comp	3.74	2.72	3.34	4.14	5.11	3.72	4.58	5.65	1.38
	Exp	3.92	3.12	3.51	4.34	5.79	3.55	5.25	6.32	1.87

4.4. Results

These results relate to the research question "Did the intervention change mindsets?". This research question asks whether the Mindset Kit caused a change in scores on the MMYC data from pupils. This was assessed utilising multi-level modelling.

4.4.1. Examination of within group variance

The first stage in multi-level modelling is to compare the difference between 'null' or 'unconditional' models. The first null model (Null Model A) does not include any grouping factors (i.e. school) whereas the second (Null Model B) does, meaning that Null Model B has random intercepts by group and Null Model A does not. These null models do not contain predictors and are computed to allow comparison of the intercept variance between groups (Bliese, 2013).

The response format of questions 8, 9, and 10 from MMYC require a different response distribution to questions 1 through 6. Therefore, two models will be computed in this stage to account for this. Questions 1 through 6 will be labelled 'a' (e.g. 1a), and questions 8, 9, and 10 will be labelled 'b' (i.e. 1b). In the 'a' models response data are categorical, meaning that the categories of anchors in the response format can be ranked or ordered (i.e. "Very happy" to "Very sad") and it is not possible to ascribe a value to them. The cumulative response distribution has been chosen as it is the most relevant family for categorical data from the available distributions (Bürkner, 2017b). In the 'b' models data are dichotomous, as data can only be one of two options (yes or no) (Howitt &

Cramer, 2003). The Bernoulli distribution was selected as this represents a single response to a dichotomous outcome (Kruschke, 2015).

Four models will be constructed for this stage:

- Null Model 1a – Question 1 through 6 without grouping
- Null Model 2a – Question 1 through 6 with grouping by school
- Null Model 1b – Question 8 through 10 without grouping
- Null Model 2b – Question 8 through 10 with grouping by school

The results of the model comparisons can be seen in Table 25. Results suggest that a multi-level model which recognises the grouping by school is a better fit to data for Questions 1-6 (Null models 1a and 2a) and Questions 8-10 (Null models 1b and 2b).

Table 25.
Model comparison results.

	Models		Difference	
Model	LOOIC	SE	LOOIC	SE
Null Model 1a	-7322.53	53.42	126.22	18.97
Null Model 1b	-7196.31	53.42		
Null Model 2a	-1227.79	16.71	1.46	3.22
Null Model 2b	-1226.33	16.17		

4.4.2. Intercept variance

To be able to consider the influence of the Mindset Kit on pupils' data the model needs to recognise the difference between the Time 0 and Time 1 data and whether the pupil was member of the experimental or comparison condition. To do this a two-way interaction will be used as the predictor. Within R and BRMS the default return for predictors with two factors is for the positive. For example, the variable “exp_comp” (experimental or comparison condition) could be 1 or 0, and BRMS would return the outputs calculated for 1. The interaction returned will have “Time” and “exp_comp” returned for 1, meaning the calculated intercepts are for those pupils who have completed the intervention. In other words, what is the influence of intervention on pupils’ mindsets over the academic year.

Two models will be constructed in this step:

- Model 1a – Questions 1 through 6 predicted by the interaction between time and condition (experimental or comparison), grouped by schools
- Model 1b – Questions 8 through 10 predicted by the interaction between time and condition (experimental or comparison), grouped by schools

As can be seen in Table 26 and 27, not all behaviours from the MMYC are different as a result of the intervention. Results may be considered statistically relevant if 0 is not included as part of the credible intervals range (CIs) (Gelman & Hill, 2007; Kruschke, 2015; McElreath, 2016). Should the credible interval range include zero but the estimate error be greater than the difference from the zero to the upper or lower bound then this suggests that there may be a relationship which was not fully uncovered or supported by current data (Krushke, 2015). To highlight the differences in these relationships and to ease interpretation of large tables any relationships which do not have zero in the credible interval bounds will be highlighted with a double asterisk symbol (**) and those which the estimate error is greater than the difference from zero to the upper or lower bound will be highlighted with a single asterisk (*). Results without any asterisk symbols were not found to be statistically meaningful. This approach of highlighting meaningful results will be adopted across all results tables where appropriate.

Table 26.
Results of Model 1a.

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Question 1	-0.04	0.29	-0.62	0.54	
Question 2	1.33	0.28	0.78	1.89	**
Question 3	-0.22	0.27	-0.74	0.31	
Question 4	0.29	0.29	-0.25	0.88	*
Question 5	0.81	0.34	0.15	1.45	**
Question 6	0.80	0.28	0.27	1.37	**

N.B. all parameters are the 2-way interaction, i.e. Question 1 predicted by Time by Condition.

Results described below are provided with the mean of the posterior distribution (Estimate) and credible intervals (in square brackets). The MMYC item which was influenced the most by the intervention was Question 2 (learning goal) (1.33 [0.78, 1.89]). This suggests a substantial increase in reported learning goal behaviours; variables are unstandardized in the regression which means a change of 1.33 units on a 1 to 6 scale. Also, the two response to success items being Question 5 (affect response to success) and Question 6 (persistence following success) both showed increases of .81 [.15, 1.45] and .80 [.27, 1.37] respectively. The results for Question 8 suggested that pupils viewed intelligence as less innate following the intervention (0.36 [-.30, 1.05]). The mean of the posterior distribution for Question 9 (belief in malleability of others intelligence) was negative -0.94 [-1.55, -0.32] which suggests that the intervention reduced overall responses to this question (i.e. created a more fixed view). Pupils belief that their own intelligence could change (Question 10) was also not increased by the intervention, -.45 [-1.22, .28]. The responses to Question 9 and 10 are opposite to what was predicted.

Table 27.
Results of Model 1b.

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Question 8	0.36	0.34	-0.30	1.05	*
Question 9	-1.04	0.34	-1.72	-0.37	**
Question 10	-0.45	0.38	-1.22	0.28	*

N.B. *all parameters are the 2-way interaction, i.e. Question 8 predicted by Time by Condition.*

The model comparisons as set out in Table 28 suggest that both models are a better fit to data than previous models.

Table 28.
Model comparison results.

	Models		Difference	
Model	LOOIC	SE	LOOIC	SE
Null Model	-7196.30	56.50	23.30	8.50
Model 1a	-7173.00	57.00		
Null Model	-1227.80	16.20	2.80	4.80
Model 1b	-1223.60	35.30		

4.4.3. Other predictors

As the results of the previous step suggested the intervention was successful at promoting growth mindsets this next step will consider if the intervention was particularly successful at promoting growth mindsets for specific groups of pupils. The model will consider if the intervention is more or less effective for male pupils, pupils with special educational needs, and pupils who speak English as an additional language. These factors will be integrated into the model as new three-way interactions.

There will be two models constructed in this step:

- Model 2a – Questions 1 through 6 predicted by the interaction between:
    - Time, Condition, and Gender
    - Time, Condition, and SEN
    - Time, Condition, and EAL

      Grouped by school
- Model 2b – Questions 8 through 10 predicted by the interaction between:
    - Time, Condition, and Gender
    - Time, Condition, and SEN
    - Time, Condition, and EAL

      Grouped by school

The results of these models are presented in Table 29 and 30 below.

Table 29.
Results of Model 2a – 3-way interaction term results

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Question 1 – Gender	0.98	0.52	-0.05	1.99	*
Question 1 – SEN	-0.54	0.96	-2.43	1.32	
Question 1 – EAL	-0.68	0.99	-2.63	1.25	
Question 2 – Gender	0.88	0.54	-0.17	1.93	*
Question 2 – SEN	-1.11	0.99	-3.04	0.84	*
Question 2 – EAL	-0.78	1.02	-2.77	1.24	
Question 3 – Gender	-0.10	0.48	-1.06	0.84	
Question 3 – SEN	-0.40	0.89	-2.12	1.39	
Question 3 – EAL	1.14	0.91	-0.66	2.91	*
Question 4 – Gender	0.28	0.52	-0.77	1.30	
Question 4 – SEN	-1.34	0.96	-3.25	0.54	*
Question 4 – EAL	-0.87	1.00	-2.79	1.13	
Question 5 – Gender	0.04	0.37	-0.69	0.76	
Question 5 – SEN	0.22	0.67	-1.09	1.53	
Question 5 – EAL	-0.07	0.69	-1.44	1.28	
Question 6 – Gender	0.91	0.51	-0.10	1.92	*
Question 6 – SEN	-0.06	0.95	-1.90	1.84	
Question 6 – EAL	<.01	0.98	-1.89	1.93	

In these results the additional predictors could highlight pupils most at risk of academic underperformance. The current analysis does not include academic performance as dependent measure but asks whether these subsets of pupils were more influenced by the Mindset Kit. Most items did not have a statistically meaningful change following the intervention. This is perhaps because a three-way interaction requires a substantially increased sample size and power to be detected (Leon & Heo, 2009). Therefore, the current results represent potentially strong effects as the sample size was not originally planned to account for three-way interactions, yet they were still statistically meaningful.

The configuration of the analysis means that the estimates reported are for pupils who are in the category, for gender this means males. Males seemed to be most receptive to developing a learning goal as can be seen from Question 1 (0.98 [-0.05, 1.99]) and Question 2 (0.88 [-0.17, 1.93]). Results also suggest that they persisted more following a success, as can be been seen in Question 6 (0.91 [-0.10, 1.92]). However, as can be seen in Table 29, males were least receptive to the idea that intelligence is not innate as results from Question 8 were negative (-1.14 [-2.39, 0.17]). There is a split between their views of others and their own ability to change their intelligence. In that, Question 9 was also negative (-0.64 [-1.92, 0.60]) and Question 10 was positive (0.73 [-0.74, 2.27]). This suggests that they consider others intelligence to be more fixed and biologically dependent than their own.

The results from pupils with special educational needs suggests that they were least receptive to the intervention as can be seen from Question 2 (-1.11 [-3.04, 0.84]) and Question 4 (-1.34 [-3.25, 0.54]). This raises questions about the accessibility of the approaches taken within the Mindset Kit. However, they were receptive to the message that intelligence is not innate, as demonstrated by the results from Question 8 (1.45 [-1.09, 4.02]). Pupils who speak English as an additional language (EAL) readily changed their affective response to failure as can be seen in the results from Question 3 (1.14 [-0.66, 2.91]). However, their views on the malleability of their own intelligence (Question 10) were in fact reduced by the intervention (-1.52 [-5.49, 1.82]). No other MMYC items were predictive.

Table 30.
Results of Model 2b

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Question 8 – Gender	-1.14	0.65	-2.39	0.17	*
Question 8 – SEN	1.45	1.31	-1.09	4.02	*
Question 8 – EAL	-0.63	1.54	-3.68	2.39	
Question 9 – Gender	-0.64	0.66	-1.92	0.60	*
Question 9 – SEN	-0.20	1.18	-2.50	2.15	
Question 9 – EAL	0.68	1.28	-1.84	3.21	
Question 10 – Gender	0.73	0.77	-0.74	2.27	*
Question 10 – SEN	-0.02	1.92	-3.62	4.15	
Question 10 – EAL	-1.52	1.87	-5.49	1.82	*

It was not possible to compute model comparison criterion values, using any means; whether Leave-one-out Cross-validation Information Criteria (LOO-IC), Widely-Applicable Information Criterion (WAIC), K-Fold Cross-validation, Bayesian Information Criterion (BIC), or Akaike Information Criterion (AIC). The software (BRMS) returned errors when computing information criterion. Therefore, it has not been possible to compare the models between this stage the previous ones.

4.5. Discussion

This discussion section relates to the research question – “Did the intervention change mindsets?” for both the overall sample and for the sub-groups identified as at risk of academic underperformance. In relation to the overall sample, the results show that the Mindset Kit increased learning behaviours but promoted fixed mindsets in respect of pupil’s own intelligence and others intelligence. Overall, there was no particular pattern revealed in relation to subgroups. Pupils with SEND were least likely to be influenced by the Mindset Kit, with males being more receptive, but EAL pupils were not substantially different from their peers. Whilst, previous research has found that the greatest benefit of a growth mindset is for pupils who may be at risk of academic underachievement (e.g. Claro, Paunesku, & Dweck, 2016), there has been no work which has explored if these groups are also more receptive to growth mindset messages. The current findings suggest that individual differences play a part in how receptive an individual is to a growth mindset message. However, the pattern is not consistent in that all groups at risk are more receptive to messages, in fact, different groups vary in how receptive they are to the messages.

Results from the whole sample showed that the intervention promoted fixed mindsets in relation to views on the malleability of intelligence for both their own intelligence and others. This is potentially because the mindset kit promotes learning behaviours such as focussing on improvements in learning, rather than achieving high marks but did not explicitly require teachers to discuss mindsets or to include the neuroscience content of other interventions, such as Blackwell et al. (2007). Yet, one of the most used elements of the Mindset Kit was verbal feedback (as found in Chapter 6). Previous research has found that process praise develops a more malleable view of intelligence (Cimpian, Arce, Markman, & Dweck, 2007; Zhao, Heyman, Chen, & Lee, 2017). It may be that the neuroscience content as presented in other interventions is needed to develop incremental theories of intelligence.

To develop a more malleable view of intelligence it may be necessary to include some neuroscience content, more akin to interventions proposed by Dweck and colleagues (e.g. Yeager et al., 2016). As discussed in the co-creation chapter, it was considered impractical to ask teachers to deliver content on which they would need training. This would be particularly challenging due to the high level of pressure on teachers who struggle to find time to attend training and also the time to deliver this content in their class schedules. There would have been a substantial development period; translating neuroscience content for use in early years classroom would be challenging. However, recent evidence has found that online interventions which cover neuroscience content can be as short as two 25-minute sessions (Yeager et al., 2019) and that these can successfully promote a growth mindset. The content presented in the Yeager et al. (2019) intervention is very much above the level that 5 to 6-year olds would be able to engage with. For example, they present information about the structure of neurons, and synaptic connections. However, in the next iteration of the development of the Mindset Kit it may be fruitful to explore this issue.

The somewhat unexpected results could be attributable to the theory the hypothesis were based upon. As previously discussed, there is a dearth of research which addresses the structure of the implicit theories framework, with only two notable exceptions (Blackwell et al., 2007; Burnette et al., 2013). The two models propose very different conceptualisations of a growth mindset and different causal structures. But both propose that an implicit theory of intelligence is the originating variable and all other behaviours and cognitions are driven by the individual's implicit theory. The current results are contrary to these models, as many learning behaviours were increased, despite the move towards an entity theory of intelligence for the self and others following the intervention. Additionally, the paths coming from implicit theories in these previous models are unidirectional, meaning that implicit theories generate the other behaviours but are not influenced by them.

The fact that pupils responded very differently to the three mindset questions raises the question as to whether individuals can hold divergent beliefs on the three concepts. For example, an individual may understand intelligence to be innate and not believe that others can change their intelligence, but they may also believe that their personal intelligence is malleable. Therefore, mindsets may vary in their structure between individuals. It could be argued that this was only found because participants in this study were so young. However, previous research with older participants supports the lack of relationship between self and other mindsets. De Castella and Byrne (2015) employed an implicit theories of intelligence scale in both a general version (e.g. "Your intelligence is something about you that you can't change very much") and a self-theory version (e.g. "My intelligence is something about me that I personally can't change very much"). They explored how the two versions influenced a range of behaviours, such as performance-avoidance goals, self-handicapping, and also academic achievement. They found that the self-version had greater explanatory power than the general-version. The current research suggests that individuals can hold multiple beliefs and it is worthy of future research. Any future research much address how these concepts relate to each other.

A growing body of evidence suggests that certain sub-populations, such as those at risk of academic underachievement may benefit more from a growth mindset (Paunesku et al., 2015; Yeager et al., 2017). However, there is no research which has explored how receptive particular populations may be to growth mindset messages. Current results suggested that if pupils were at risk of academic underachievement, (i.e. were male, or had special educational needs or disabilities) they were likely to interact with the intervention messages differently to their peers. Males seemed to have mindsets which were easier to change, whereas SEN pupils were somewhat less receptive to growth mindset messages, and EAL pupils did not seem to be particularly influenced by the Mindset Kit.

Current findings suggest that SEN pupils seemed to be most receptive to understanding that intelligence is not innate but were much less receptive to changing their learning behaviours. Prior research reports that pupils with SEND often require more support to change behaviours and the process may take more time than for other pupils (Davis et al., 2004; Reed, Osborne, & Waddington, 2012). Therefore, whilst the intervention integrated into existing practice with minimal changes to teachers' pedagogical practice. It may be that

SEND pupils require additional support for growth mindsets to be successfully promoted within this population. Future research would have to address the most effective way to do this.

Pupils who speak English as an additional language were not substantially different from their peers in respect of being receptive to the messages of the intervention with only two items changing to a statistically meaningful extent compared to their peers. These items were an increase in their positive affective response to failure (Question 3) and a more entity theory of intelligence (Question 10). Pupils who come from families in which English is not their primary language are likely to have a home life which mirrors cultural patterns from a different culture (Trickett & Birman, 2005). A recent meta-analysis found that mindsets operate differently in different cultures in relation to achievement (Costa & Faria, 2018). Costa and Faria (2018) observed that students from Asia and Oceania had a positive association between a growth mindset and achievement yet European students with a fixed mindset had higher achievement. What research does not cover is how different cultures may respond differently to growth mindset messages. Future research needs to address this and learn more about how children with different cultural backgrounds living in the UK may view mindsets.

In conclusion, these findings highlight that individual differences played a role in how effective the Mindset Kit was. Male pupils were positively receptive to adopting an incremental theory of intelligence (Question 10), whereas EAL pupils were almost oppositely negatively receptive. Yet there was no statistically meaningful difference between SEND pupils and their peers on this item. If an implicit theory of intelligence dictates all other aspects of a growth mindset (Blackwell et al., 2007) then it seems pertinent to address how to best promote this to different populations. Therefore, future research should explore whether future versions of the Mindset Kit should be developed to include direct instruction about neuroplasticity as seen in Blackwell et al., (2007) and Yeager et al. (2019). They also suggest there is need for researchers to explore in detail the nature of the structure of implicit theories framework; does an implicit theory of intelligence dictate other behaviours? Such work should employ experimental manipulations of mindsets and the associated learning behaviours in laboratory settings. Additionally, analyses suggest that there are individual differences (e.g. SEN and gender) which influence an individual's receptiveness to mindset messages. This highlights that there is a need for further work to explore for whom and when a mindset intervention may be most appropriate. Some pupils may need a more targeted approach, potentially for those who may benefit most from a growth mindset (Yeager et al., 2014).

4.6. Results

These results address the research question "Are mindsets related to academic performance?". This research question asks whether mindsets are related to academic performance using a cross-sectional approach that will explore the relationship between achievement and mindset at both time points regardless of experimental condition membership. It is appropriate to take such an approach as this question is framed universally; regardless of other factors is there evidence in the current research that mindsets are related to academic achievement? This will be assessed utilising multi-level modelling, even though the hierarchically structured nature of data is not specifically of interest, it is still appropriate to recognise the structure of these data. As discussed above, models will be compared using the Leave-one-out information criterion (LOOIC) approach. As MMYC data are now predictors in these models, it is possible to specify distribution families per response variable. Therefore, the models will still recognise the difference in distributions between questions 1 through 6 and 8 through 10 without requiring separate 'a' and 'b' models as in the previous question.

4.6.1. Examination of within group variance

The first stage in multi-level modelling is to compare the difference between two 'null' or 'unconditional' models. These null models do not contain predictors and are computed to allow comparison of the intercept variance between groups (Bliese, 2013).

The following models will be constructed in this step:

- Phonics Null Model 1 – no grouping
- Phonics Null Model 2 – with grouping by school
- Reading Null Model 1 – no grouping
- Reading Null Model 2 – with grouping by school
- Comprehension Null Model 1 – no grouping
- Comprehension Null Model 2 – with grouping by school

The results of the comparison can be seen in Table 31. Results suggest that a multi-level model which recognises the grouping and correlation of responses by School is a better fit to data.

Table 31.
Leave-one-out information criterion for Question 2 unconditional models.

	Models		Difference	
Model	LOOIC	SE	LOOIC	SE
Phonics Null 1	-2587.60	17.40	8.30	3.90
Phonics Null 2	-2579.30	17.50		
Reading Null 1	-2456.70	19.00	4.50	3.40
Reading Null 2	-2452.20	18.70		
Comprehension Null 1	-1679.30	10.70	6.40	3.60
Comprehension Null 2	-1672.90	10.70		

4.6.2. Intercept variance

The initial model does not include any additional predictors beyond the MMYC, this is to show the influence of the MMYC without accounting for other sources of variance. It also allows a baseline model from which to consider how mindsets may be moderated by other variables of interest (gender, EAL, SEN).

Three models will be constructed in this step:

- Phonics predicted by Question 1 through 10, grouped by school
- Reading predicted by Question 1 through 10, grouped by school
- Comprehension predicted by Question 1 through 10, grouped by school

The results from the models are presented in Table 32 below. Overall, there is a positive pattern between most of the MMYC items and performance on the phonics, reading, and comprehension tests. There are some noticeable patterns, which will be discussed as opposed to considering each response individually. In respect of learning and performance goals there is a clear pattern that learning goals (Question 2) increase achievement (phonics = 0.75 [0.12, 1.39]; reading = 0.80 [0.20, 1.40]; comprehension = 0.25 [0.10, 0.40]). Question 1 is reverse coded so that whilst the question proposed a performance goal the effect of the predictor was hypothesised to have a positive relationship with achievement. However, whilst there was no statistically meaningful relationship with phonics or comprehension performance, there was a negative association with reading (-.047 [-1.10, 0.15]). Responses to failure, both affective and persistence (Questions 3 and 4 respectively) were found to have positive associations with phonics performance (0.42 [-0.28, 1.11] and 0.36 [-0.30, 1.01]). Persistence following failure (Question 4) also had a statistically meaningful relationship with comprehension (0.18 [0.02, 0.34]) but neither question had a relationship with Reading.

Affective response to success had a negative association with phonics (-0.69, [-1.60, 0.23]), reading (-0.98 [-1.86, -0.11]), and comprehension (-0.24 [-0.46, -0.01]). However, persistence following success (Question 6) is positively predictive of pupil achievement in comprehension (0.13 [-0.02, 0.29]). Finally, viewing intelligence as not innate (Question 8) provided the strongest benefits to pupils of all MMYC items; for phonics (4.65 [2.52, 6.76]), reading (4.05 [2.03, 6.07]), and comprehension (0.88 [0.36, 1.40]). It is noteworthy that the effect fades as the tasks become more cognitively demanding. The view that others can develop their intelligence (Question 9) only influenced comprehension (0.35 [-0.21, 0.90]). This contrasts with the view that pupils can develop their own intelligence (Question 10) which has a consistently negative relationship with outcomes: phonics (-4.26 [-6.81, -1.70]), reading (-2.54 [-5.07, -0.07]), and comprehension (-0.79 [-1.42, 0.17]).

Table 32.
Model results for Question 2 intercept models.

Parameter	Question	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Phonics	1	0.07	0.34	-0.59	0.72	
	2	0.75	0.32	0.12	1.39	**
	3	0.42	0.36	-0.28	1.11	*
	4	0.36	0.33	-0.30	1.01	*
	5	-0.69	0.47	-1.60	0.23	*
	6	0.03	0.32	-0.60	0.67	
	8	4.65	1.08	2.52	6.76	**
	9	-0.62	1.16	-2.87	1.64	
	10	-4.26	1.30	-6.81	-1.70	**
Reading	1	-0.47	0.32	-1.10	0.15	*
	2	0.80	0.30	0.20	1.40	**
	3	0.03	0.34	-0.65	0.71	
	4	0.13	0.32	-0.49	0.76	
	5	-0.98	0.45	-1.86	-0.11	**
	6	-0.06	0.31	-0.67	0.54	
	8	4.05	1.04	2.03	6.07	**
	9	-0.27	1.11	-2.45	1.91	
	10	-2.54	1.26	-5.02	-0.07	**
Comprehension	1	-0.01	0.08	-0.17	0.15	
	2	0.25	0.08	0.10	0.40	**
	3	0.05	0.09	-0.11	0.22	
	4	0.18	0.08	0.02	0.34	**
	5	-0.24	0.11	-0.46	-0.01	**
	6	0.13	0.08	-0.02	0.29	*
	8	0.88	0.27	0.36	1.40	**
	9	0.35	0.28	-0.21	0.90	*
	10	-0.79	0.32	-1.42	0.17	*

The results in Table 33 suggest that the current models are a better fit for the data than the null models.

Table 33.
Output from Question 2 intercept models.

Model	LOOIC	SE	Difference	SE
Phonics Null Model	-2579.30	17.50	12.20	6.20
Phonics Model 1	-2567.10	17.70		
Reading Null Model	-2452.20	18.70	6.20	5.60
Reading Model 1	-2446.10	18.70		
Comprehension Null Model	-1672.90	10.70	12.50	7.10
Comprehension Model 1	-1660.50	12.40		

4.6.3. Additional predictors

As the results of the previous step suggested the intervention was successful at promoting growth mindsets this step will consider if growth mindsets are particularly predictive of academic performance for specific groups of pupils. The model will consider if the intervention is more or less effective for male pupils, pupils with special educational needs (SEN), and those who speak English as an additional language (EAL). These factors identify pupils who may be at risk of academic under achievement, and as previous research suggests may benefit most from having a growth mindset. As there are many potential predictors and three outcome variables of interest, each set of predictors will be considered by outcome variable separately, being phonics, reading, and comprehension.

Phonics Model 2:

- Phonics predicted by
  - Question 1 through 10 x Gender
  - Question 1 through 10 x SEN
  - Question 1 through 10 x EAL

    All grouped by school

  N.B. The symbol 'x' means 'interacted with'

The results presented in Table 34 below will be discussed in terms of each item from the MMYC in relation to the predictor of interest: gender (males), SEN, and EAL. Performance goals (Question 1) had no relationship with gender but are negatively predictive of Phonics performance for pupils in the SEN (-0.65 [-1.50, 0.25]) and EAL (-0.74 [-1.73, 0.27]) categories. It would be expected that learning goals (Question 2) would be beneficial to achievement, however, this is only the case for pupils in the SEN category (0.62 [-0.38, 1.61]). Having a positive affective response to failure had one statistically meaningful relationship which was negatively related to performance for pupils in the SEN category (-0.99 [-1.91, -0.06]). As would be expected persistence following failure was positively predictive of phonics performance, but only for male pupils (0.25 [-0.23, 0.74]) and SEN category (1.01 [0.05, 1.96]). Positive affect following success (Question 5) was only negatively predictive of phonics learning for males (-0.39 [-1.06, 0.25). The only relationship between persistence following success (Question 6) and phonics performance was found for EAL pupils (0.51 [-0.37, 1.38]). Males had the strongest positive benefit of all MMYC items in the belief that not all people are born clever (Question 8; 1.31 [-0.23, 2.89]), however this was not found for the other categories. Question 9 which asks pupils whether other people can change their intelligence was found to be negatively predictive for achievement for pupils in the SEN category but not others (-8.07 [-11.31, -4.86]). Question 10 which asks pupils whether they can change their own intelligence was only negatively predictive for males (-1.61 [-3.51, 0.33).

Table 34.
Results of Model 2 for Phonics – Interactions between MMYC question and Gender, SEN, and EAL

Parameter	Question	Estimate	Estimate Error	Low 95% CI	High 95% CI	
	Intercept	92.42	2.38	87.61	97.23	**
Gender	1	0.11	0.24	-0.35	0.59	
	2	0.04	0.24	-0.43	0.51	
	3	-0.25	0.27	-0.76	0.28	
	4	0.25	0.24	-0.23	0.74	*
	5	-0.39	0.33	-1.06	0.25	*
	6	-0.08	0.23	-0.53	0.37	
	8	1.32	0.80	-0.23	2.89	*
	9	-0.04	0.86	-1.75	1.63	
	10	-1.61	0.99	-3.51	0.33	*
SEN	1	-0.65	0.45	-1.50	0.25	*
	2	0.62	0.51	-0.38	1.61	*
	3	-0.99	0.47	-1.91	-0.06	**
	4	1.01	0.49	0.05	1.96	**
	5	0.81	0.67	-0.50	2.12	*
	6	0.41	0.46	-0.48	1.31	
	8	1.68	1.92	-2.08	5.38	
	9	-8.07	1.69	-11.31	-4.86	**
	10	0.67	2.58	-4.48	5.63	
EAL	1	-0.74	0.51	-1.73	0.27	*
	2	0.06	0.49	-0.91	1.04	
	3	-0.06	0.62	-1.27	1.16	
	4	-0.29	0.51	-1.30	0.74	
	5	-1.11	1.27	-3.57	1.36	
	6	0.51	0.44	-0.37	1.38	*
	8	0.60	1.89	-3.17	4.29	
	9	-1.03	1.64	-4.21	2.27	
	10	0.56	2.03	-3.40	4.63	

Reading Model 2:

The models were constructed thus:

- Reading predicted by
    - Question 1 through 10 X Gender
    - Question 1 through 10 X SEN
    - Question 1 through 10 X EAL

      Grouped by school

  N.B. The symbol 'x' means 'interacted with'

The results of the Reading Model 2 which explored reading performance for pupils who were male, have special educational needs (SEN), and speak English as an additional language (EAL) are presented in Table 35 below. Results will be discussed in respect of each category as opposed to each MMYC item. For males Question 1 (performance goal) was positively predictive of comprehension performance (0.71 [-0.12, 1.54]) whereas Question 2 (learning goal) was negatively predictive (-0.45 [-1.20, 0.28]). A positive affective response to failure (Question 3) was negatively predictive of reading performance (-0.91 [-1.77, -0.06]) which is contrary to theory but in-line with other findings for males and this MMYC item. No other items were statistically meaningful for males and reading performance. The first MMYC item to have a statistically meaningful relationship with reading performance within the SEN category was Question 3 (affective response to failure). A similarly negatively predictive pattern was found for pupils in the SEN category as with males (-1.02 [-2.69, 0.65]). However, pupils in this category who had a positive affective response to success (Question 5) did perform better (1.49 [-0.83, 3.69]). Finally, results from Question 9 (a belief that others can change their intelligence) had a negative impact on SEN pupil's reading achievement (-3.63 [-8.84, 1.29]). Whilst this finding is contrary to theory it may have a social comparison element which will be discussed later. Pupils who spoke English as an additional language did not benefit from not holding a performance goal (item is reverse coded; higher scores denote disagreement) as found in the results from Question 1 (-0.927 [-2.68, 0.70]). This is opposite to the findings of males and what was hypothesised. The results of Question 4 (persistence following failure) were found to have a negative relationship with achievement (-2.00 [-3.63, -0.32]). Finally, EAL pupils who persisted following success (Question 6) were found to have improved achievement (1.06 [-0.36, 2.54]).

Table 35.

Results of Model 2 for Reading – Interactions between MMYC question and Gender, SEN, and EAL

Parameter	Question	Estimate	Estimate Error	Low 95% CI	High 95% CI	
	Intercept	97.12	3.66	90.18	104.29	**
Gender	1	0.71	0.42	-0.12	1.54	*
	2	-0.45	0.37	-1.20	0.28	*
	3	-0.91	0.45	-1.77	-0.06	**
	4	-0.05	0.43	-0.89	0.80	
	5	0.32	0.58	-0.81	1.46	
	6	-0.24	0.39	-1.00	0.55	
	8	-0.70	1.39	-3.40	2.09	
	9	0.81	1.46	-2.05	3.68	
	10	-0.49	1.69	-3.80	2.79	
SEN	1	-0.55	0.77	-2.04	0.95	
	2	-0.10	0.82	-1.69	1.50	
	3	-1.02	0.84	-2.69	0.65	*
	4	0.22	0.80	-1.34	1.79	
	5	1.49	1.15	-0.83	3.69	*
	6	0.06	0.77	-1.42	1.57	
	8	1.05	3.14	-5.22	6.98	
	9	-3.63	2.60	-8.84	1.29	*
	10	-1.81	3.85	-9.42	5.49	
EAL	1	-0.97	0.85	-2.68	0.70	*
	2	-0.29	0.81	-1.86	1.29	
	3	0.03	1.01	-1.96	1.96	
	4	-2.00	0.84	-3.63	-0.32	**
	5	1.90	2.53	-3.13	6.87	
	6	1.06	0.75	-0.36	2.54	*
	8	-0.44	2.95	-6.33	5.18	
	9	1.55	2.63	-3.58	6.75	
	10	0.31	3.26	-6.04	6.74	

Comprehension Model 2 –

The models were constructed thus:

- Comprehension predicted by
    - Question 1 through 10 X Gender
    - Question 1 through 10 X SEN
    - Question 1 through 10 X EAL
      Grouped by school

  N.B. The symbol 'x' means 'interacted with'

The results in Table 36 below will be explored in relation to each category of pupil, being: males, those with special educational needs (SEN), and those who speak English as an additional language (EAL). Again, as with reading performance, males' performance was negatively influenced by their affective response to failure (Question 3); the more positive their affect the lower their performance (-0.23 [-0.49, 0.02]). The only other MMYC item which influenced males comprehension performance was Question 8 (their view that intelligence is not innate). This was found to have a negative influence on performance (-0.48 [-1.23, 0.32]). Pupils with special educational needs were found to have a negative relationship with both learning goals (Question 1; -0.32 [-0.75, 0.14]) and performance goals (Question 2; -0.28 [-0.76, 0.22]). The only other relationship within the SEN category was between Question 8 (a view that intelligence is not innate) which was negative (-1.59 [-3.50, 0.33]). Only two MMYC items had a relationship with comprehension for EAL pupils. Persistence following success (Question 5) had a negative relationship (-1.53 [-2.75, -0.27]). Finally, a belief that the individual can change their intelligence (Question 10) was also negatively associated with comprehension performance (-1.33 [-3.27, 0.63]).

Table 36.
Results of Model 2 for Comprehension – Interactions between MMYC question and Gender, SEN, and EAL

Parameter	Question	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Gender	1	-0.03	0.12	-0.28	0.21	
	2	-0.04	0.11	-0.27	0.18	
	3	-0.23	0.13	-0.49	0.02	*
	4	-0.08	0.12	-0.33	0.17	
	5	0.14	0.17	-0.19	0.47	
	6	-0.09	0.11	-0.31	0.13	
	8	-0.48	0.40	-1.23	0.32	*
	9	0.18	0.43	-0.70	1.04	
	10	-0.12	0.50	-1.09	0.83	
SEN	1	-0.32	0.23	-0.75	0.14	*
	2	-0.28	0.25	-0.76	0.22	*
	3	0.14	0.24	-0.32	0.59	
	4	0.06	0.25	-0.43	0.55	
	5	0.02	0.33	-0.61	0.68	
	6	0.11	0.24	-0.35	0.57	
	8	-1.59	0.98	-3.50	0.33	*
	9	-0.10	0.85	-1.77	1.56	
	10	-0.98	1.33	-3.67	1.63	
EAL	1	-0.08	0.26	-0.58	0.42	
	2	-0.18	0.24	-0.65	0.30	
	3	-0.16	0.30	-0.77	0.43	
	4	-0.13	0.26	-0.65	0.40	
	5	-1.53	0.63	-2.75	-0.27	**
	6	0.19	0.23	-0.27	0.63	
	8	0.56	0.98	-1.39	2.45	
	9	0.33	0.83	-1.31	1.95	
	10	-1.33	1.00	-3.27	0.63	*

It was not possible to compute model comparison criterion values, using any means; whether Leave-one-out Cross-validation Information Criteria (LOO-IC), Widely-Applicable Information Criterion (WAIC), K-Fold Cross-validation, Bayesian Information Criterion (BIC), or Akaike Information Criterion (AIC). The software (BRMS) returned errors when computing information criterion. Therefore, it has not been possible to compare the models between this stage the previous ones.

4.7. Discussion

This discussion addresses the research question “Are mindsets related to academic performance?”. Overall, results of these analyses are mixed, the three outcome variables (phonics, reading, and comprehension), combined with the nine MMYC items generates twenty-eight total effects in the first analysis. Of these, nine did not have a statistically meaningful relationship, seven had a negative relationship with performance, and eleven had a positive relationship. Most strikingly, pupils who understood their own intelligence to be malleable had lower achievement than their peers. Previous research has found that groups most at risk of educational underachievement benefit the most from a growth mindset (Yeager, Romero, et al., 2016; Yeager, Walton, et al., 2016). However, a similar pattern was not found in current data; there were no clear patterns which suggest any of the groups in the current study who were identified as potentially at risk of academic underachievement clearly benefitted more from a growth mindset than their peers.

Within the overall sample (without sub-groups) the most striking finding is that implicit theories of intelligence were not predictive of positive achievement. There are several potential explanations as to why the self-mindset MMYC item which asked pupils "Do you think that you can you change how clever you are?" had a negative influence on achievement. The first explanation relates to the construction of the implicit theories framework. As previously discussed, there is a small amount of research which has explored the relationships between the constructs within the framework (e.g. how do implicit theories relate to achievement). Blackwell et al. (2007) presented a model in which there is no direct link between theory of intelligence and achievement (e.g. implicit theories predicted learning goals, which predicted positive strategies, which predicted achievement). Yet Burnette et al. (2013) did suggest a direct link between implicit theory and goal achievement, which is the assumption of much contemporary research into mindset-based interventions (e.g. Paunesku et al., 2015). However, both Burnette et al. (2013) and Blackwell et al. (2007) propose that incremental theories of intelligence drive change on other elements of a growth mindset, such as learning goals and responses to failure. Previous findings from Chapter 2 suggest that the framework does not seem to hold together as suggested by either model; there were limited relationships found between any of implicit theories items in the MMYC data, and the replication of the Blackwell et al. (2007) model failed. Therefore, it may be that implicit theories may be an originating variable in the framework but have a negative direct relationship with achievement. However, considering the body of repeated positive findings between implicit theory of intelligence and achievement this seems less likely, but may still be possible.

Another potential explanation is to do with the wording of the question itself. The question was modelled on existing adult measures but with wording that was designed to be accessible to young children. Within the MMYC there is no directionality inferred in the question – "Do you think you can change how clever you are?" to which participants may respond with yes or no. For most adults, the implicit understanding of the question is that by responding "yes" you would hold a view that you can positively develop your intelligence. However, it may be that the young children sampled within the current research may not have this implicit understanding and by responding yes may hold the understanding that intelligence can be increased or decreased. As highlighted by Kinlaw and Kurtz-Costes (2003) research examining young children's views on the stability of intelligence is inconclusive. Some research has found most young children believe in only positive development of intelligence, whereas others have not found this pattern. Indeed, in their later work Kurtz-Costes, McCall, Kinlaw, Wiesen, and Joyner (2005) reported cultural variations between young children in the United States and Germany; children in the U.S. were more likely to view intelligence as malleable and that the hardest working children are the most intelligent. Therefore, it may be that the current sample of children understood intelligence to be malleable, but in a negative direction (i.e. they can get less intelligent). Revising the MMYC item to include directionality may be advantageous to future research.

Previous research has found achievement goals to be a reliable predictor of achievement (Huang, 2012; Hulleman, Schrager, Bodmann, & Harackiewicz, 2010; Van Yperen, Blaga, & Postmes, 2015). The current study provides support for such findings, as learning goals were generally positively predictive of achievement across all domains (phonics, reading, and comprehension). However, learning goals were negatively predictive of achievement for males in respect of sentence reading. Previous research has suggested that even young males may be influenced by wider societal stereotypes of boys in education, which in turn may be reflected in their attitudes towards education (Garwood, Varghese, & Vernon-Feagans, 2017; Patterson, 2012). For young males this can mean lack of engagement as a result of stereotype threat; that young boys who may have academic potential inhibit themselves by adopting stereotypical behaviours which are detrimental to achievement (Aronson et al., 1999; Patterson, 2012). In some circumstances, individuals' stereotypes may inhibit them from meaningfully engaging with scenarios presented in the research process. For example, in the current research, some males may have been unable to picture themselves 'getting everything right' and therefore been unable to place themselves within the scenario presented. Without further research, which would need to be qualitative to explore how these young males understood the question, it is not possible to draw concrete conclusions on this point. Yet, globally it is possible to conclude that learning goals were generally positively predictive of performance.

There is a substantial body of literature that has found that pupils' responses to failure are predictive of their future achievement (for a review see Haimovitz & Dweck, 2017). In the current study both affective responses to failure and persistence following a failure were measured. However, results were mixed on a global level, i.e. when data were not explored by pupil category. It is possible to understand these results by considering the conceptualisation of responses to failure as orientated around very short-term tasks within the wider literature.

Often short-term tasks are utilised to generate the responses to failure, for example Mueller and Dweck (1998) utilised Raven's matrices. These tasks are usually short-term and do not necessarily represent how skills or knowledge are developed in a classroom over time. In the current data, positive associations between both affective response to failure and persistence following failure were found for phonics, no relationships existed for sentence reading, and only persistence was predictive of comprehension performance. The phonics assessment within PERA (McCarthy & Ruttle, 2012) requires pupils to accurately decode graphemes into phonemes, a process in which there are many opportunities for failure. Each individual grapheme could be considered as a 'task', which subsequently builds into word production, and later comprehension. However, comprehension is a more global skill requiring many elements for pupils to become expert, such as word decoding and wider vocabulary (Castles, Rastle, & Nation, 2018). With a more complex task such as comprehension pupils may not view a single mistake as problematic as it is a skill which they recognise as developing over a longer period. Whereas, decoding graphemes (phonics) is a skill which they will be able to understand as something they can or cannot do in that moment. Therefore, affect and persistence would be predictive of phonics performance as with so many opportunities for meaningful failure (at the moment of decoding) learning would be increased when the pupil does not catastrophize and persists. However, with comprehension, mistakes may not be as meaningful but persistence over time is critical for developing comprehension skills. This suggests that there is need for research which explores the impact of responses to failure in relation to more substantive skills developed over time.

Affective responses to success were found to be negatively predictive of achievement. As with other MMYC items which measure a fixed mindset component (e.g. performance goal), responses to success were reverse coded. As it was assumed that pupils who are less happy about a success would be demonstrating a growth mindset. If this item were to be considered without reverse coding it means that pupils' who reported being happy with their success achieve more. This reason for this is likely due to the question, because the question asks pupils if they were happy with a drawing which they got right. Whilst the initial conceptualisation of the question was based upon the assumption that being less satisfied with success would denote a growth mindset, it would appear that it is a measure of pupils' immediate desire to achieve. As Ryan and Deci (2000) highlighted, extrinsic motivation may represent external control and a desire to achieve a separate goal. In other words, pupils may be more motivated by getting something right and pleasing their teachers than their own internal motivations during the learning process. In this case pupils understand achievement as being 'good' and what they are supposed to do (Harden, 2012). The negative relationship with achievement would seem to have come from pupils responding because they like to achieve, those that did not were likely pupils who were disengaged from their learning.

Similarly, to the findings of Chapter 2, the growth mindset framework does not seem to sit together as prescribed in the literature. The theory, and to a certain degree contemporary evidence, suggests that there would be a positive relationship between holding a growth mindset and achievement. Current results do not fully support this. A majority of research often utilises only theory of intelligence instruments, and using these measures reports a positive impact of theory of intelligence on performance (e.g. Paunesku et al., 2015). However, the current results found negative relationships between theory of intelligence and achievement. As discussed above, this may be due to pupils' understanding of the question. However, there are several other conclusions which can be drawn from these results. Firstly, the framework may not hold as predicted. As current results show the benefits of the different elements do not provide a homogenous positive benefit to pupils, yet this was expected based upon previous research and theory. Future research must address this finding in greater detail by exploring, over time, how the different elements of a growth mindset influence learning. Secondly, many contemporary online based interventions (e.g. Yeager et al., 2019) deliver content primarily on neuroplasticity; that we can develop our brains at the cellular level which in turn has educational advantages. Whilst this was not thought feasible during the development of the Mindset Kit, if it is essential to help pupils understand growth mindsets, it may be an inhibitory factor in creating growth mindset cultures within early years classrooms. Further research and development are needed to explore whether it is possible to effectively communicate these messages and whether they are a necessary element to helping pupils develop a growth mindset. Thirdly, results suggested that for different categories of pupils potentially at risk of academic underachievement a growth mindset may not be universally beneficial. Other researchers have suggested targeting mindset interventions to those who may benefit the most such as those from lower socio-economic backgrounds (e.g. Yeager, Walton, et al., 2016). Current findings would support this notion, but also suggest that more detailed work is required to fully understand which groups would benefit and importantly, why they would benefit from a growth mindset. Further experimental work is required to fully understand the relationships between the components on the framework and how changing proximal elements may influence theory of intelligence.

4.8. Results

These results address the research question - “Does the intervention improve academic performance?”. This question asks whether the intervention has improved academic performance. In that, does the change in mindset afforded through the intervention result in stronger academic performance for the experimental group. These results were broken down by the sub-groups listed above but these results were not statistically meaningful. This was likely due to the fact they were based upon a four-way interaction and the sample size was insufficient to allow any relationships to be detected. Therefore, the ‘other predictors’ stage was not included. As MMYC data are now predictors in these models, it is possible to specify distributions families per response variable. Therefore, the models will still recognise the difference in distributions between questions 1 through 6 and 8 through 10 without requiring separate ‘a’ and ‘b’ models as in the previous question. As discussed above, models will be compared using the Leave-one-out information criterion (LOOIC) approach.

4.8.1. Examination of within group variance

This step was not carried out because the construction would have been identical to the same step in the previous research question as phonics, reading, and comprehension are the outcome variables of interest. Models which recognise the grouping by school will be adopted for this question.

4.8.2. Intercept variance

The models presented below do not include any additional predictors beyond the MMYC, this is to show the influence of the MMYC without accounting for other sources of variance. It also allows a baseline model from which to consider how mindsets may be moderated by other variables of interest (gender, EAL, SEN). Initially it is appropriate to compare the models to the null model (with groups) to see if the models including the MMYC items as predictors fit the data better.

The models are constructed thus:

- Phonics, reading, and comprehension predicted by
    - Time x condition x Question 1 through 10
      Grouped by school

  N.B. The symbol 'x' means 'interacted with'

The results of this model are presented in Table 37 below. These will be explored by the outcomes, i.e. phonics, then reading, and finally comprehension. Within phonics, only performance goals (Question 1) and learning goals (Question 2) are predictive of performance. Question 1 has a positive relationship (1.67 [-0.88, 4.21]) and Question 2 has a negative relationship (-2.59 [-5.02, -0.14]).

A similar pattern of Question 1 having a positive relationship (0.63 [0.10, 1.16]) and Question 2 having a negative relationship (-0.45 [-0.99, 0.06]) is mirrored for reading. However, responses to failure both affective (Question 3) and persistence following (Question 4) are both positively predictive of reading performance (0.52 [-0.07, 1.10] and 0.27 [-0.24, 0.77] respectively). Responses to success (Questions 5 and 6) did not show any relationship with reading performance. However, Question 8 which explores a pupil's view of the innate-ness of intelligence, which had been previously found to be negatively predictive of performance, was found to be positively predictive of reading ability (1.06 [-0.68, 2.77]). A belief that others can change their intelligence (Question 9) was also positively predictive of reading performance (2.83 [1.00, 4.68]). Yet there is notably no relationship between a pupil's view of their own ability to develop their intelligence and reading performance.

Performance goals were positively predictive of comprehension achievement (0.80 [0.18, 1.42]) and learning goals were negatively predictive (-0.62 [-1.24, -0.01]). Similarly, to reading goals, positive affective response to failure (Question 3) was positively predictive of comprehension ability (0.56 [-0.11, 1.24]). Also, comparable to reading, pupil's comprehension scores were increased by Question 8 (1.31 [-0.70, 3.36]) and Question 9 (2.09 [-0.08, 4.24]).

Table 37.
Results of Model 1 – the influence of the intervention at Time 1 on phonics, reading, and comprehension performance

Question	Estimate	Estimate Error	Low 95% CI	High 95% CI	
Phonics					
1	1.67	1.29	-0.88	4.21	*
2	-2.59	1.26	-5.02	-0.14	**
3	0.43	1.35	-2.21	3.13	
4	-0.65	1.16	-2.96	1.56	
5	-0.12	1.79	-3.67	3.43	
6	-0.11	1.22	-2.45	2.29	
8	1.61	3.54	-5.42	8.69	
9	1.45	3.77	-5.87	8.79	
10	1.00	3.99	-7.00	8.79	
Reading					
1	0.63	0.27	0.10	1.16	**
2	-0.45	0.27	-0.99	0.06	*
3	0.52	0.30	-0.07	1.10	*
4	0.27	0.26	-0.24	0.77	*
5	0.06	0.39	-0.71	0.83	
6	-0.18	0.26	-0.69	0.33	
8	1.06	0.88	-0.68	2.77	*
9	2.83	0.94	1.00	4.68	**
10	-0.27	1.07	-2.39	1.77	
Comprehension					
1	0.80	0.32	0.18	1.42	**
2	-0.62	0.31	-1.24	-0.01	**
3	0.56	0.34	-0.11	1.24	*
4	0.18	0.31	-0.43	0.78	
5	0.08	0.44	-0.79	0.94	
6	-0.14	0.30	-0.71	0.44	
8	1.32	1.02	-0.70	3.36	*
9	2.09	1.10	-0.08	4.24	*
10	0.31	1.19	-1.99	2.63	

The usual progression into a third modelling step which would investigate additional predictors has not been included. This is because the step was carried out with a four-way interaction adding in the category identifies as in the previous research question: Time X Condition X MMYC item X (Gender/SEN/EAL). However, no results were statistically meaningful.

4.9. Discussion

This discussion section considers the research question "Did the intervention improve academic performance?". Overall, the results from the current analyses offer somewhat disparate evidence as limited relationships between MMYC items and phonics performance were found. However, the pattern of influence that mindsets had were similar between reading and comprehension. Additionally, the results are somewhat different between the current analyses and those addressing the previous research question. This may be because the current results explore the impact of the intervention and they are likely to be much less heterogeneous than previous analyses.

Previous analyses which assessed how mindsets influenced performance without considering the influence of the intervention found that self-mindset was negatively predictive of performance, however, following the intervention there is no statistically meaningful relationship with performance on any outcome. This is particularly surprising and supports Dweck's (2000) theory less than the previous findings, as although that relationship was previously found to be negative it is plausible that previously the issue lay in the question wording rather than the lack of relationship. Whereas, now there is no association with self-mindset and achievement. It may be that the only way to promote a self-mindset, and one which is beneficial to learning, is to directly instruct pupils on the neuroscience of development (e.g. Blackwell, Trzesniewski, & Dweck, 2007; Yeager et al., 2019).

However, it may not be as simple as included neuroscience content is the key to promoting self-growth mindsets which are positively predictive of achievement as suggested by others (e.g. Yeager et al., 2019). There have been some notable failures to replicate and indeed negative relationships between growth mindsets and achievement have been reported (e.g. Bahník & Vranka, 2017). Yet, in the current research, pupils' understanding of others ability to develop their intelligence was positively predictive of achievement. It may be that the growth mindset culture generated by the Mindset Kit allowed pupils to witness their peer's development which in turn influenced their view of others' abilities to develop their intelligence. However, this may not have influenced their own implicit theory of intelligence. This supports previous findings that individuals hold a separate self and other theory of intelligence (De Castella & Byrne, 2015). Yet this may have been insufficient to create a malleable view of their own intelligence which could drive achievement.

There is some disparity between the results of the current analysis and the previous research question which addressed performance and mindsets for all pupils in the study without accounting for condition. Previously, similar patterns were found between all three outcomes (phonics, reading, and comprehension). However, in the current analysis only performance and learning goals were predictive of phonics achievement. It may be that a growth mindset is not necessarily beneficial for learning processes which concern smaller repeated tasks (such as decoding graphemes into phonemes). Whereas, their benefit may be found in more cognitively demanding tasks, such as whole sentence reading and comprehension. This finding is in line with previous research, for example Yeager et al. (2019) who sampled high school students found positive relationships between having a growth mindset and performance in mathematics, science, English, and social studies. At this level of education assessments would be more challenging and incorporate a much larger breadth of knowledge. The current research did not aim to address this question and the differentiation between tasks was merely a coincidental element of the reading assessment employed. As previous research has begun to highlight that individuals may have domain specific mindsets, e.g. a reading mindset (Petscher, Al Otaiba, Wanzek, Rivas, & Jones, 2017) or a language mindset (Lou & Noels, 2016), researchers need to now address whether mindsets are beneficial for both shorter- and longer-term learning processes.

4.10 General Discussion

The evidence presented in this chapter, in-line with previous data in this thesis, suggests that the self-theories framework may not be as clearly linked to learning as some research claims.

Recent meta-analyses have suggested that performance approach goals may have beneficial effects (Hulleman et al., 2010; Senko & Dawson, 2017). Critically these are for performance approach goals with a normative element in the items, for example, “My goal is to get a better grade than most of the students” (Elliot & Church, 1997). As opposed to performance approach goals with an appearance component, for example, “One of my goals is to show others that I’m good at my class work” (Midgley et al., 2000). The performance goal item within the MMYC could potentially be interpreted as either but would likely be categorised as a general performance approach goal subtype, for example, “It is important for me to establish a good overall grade-point” (Harackiewicz et al., 2000). In both meta-analyses the general subtype did not have any substantial effects on achievement. It may be that the MMYC performance goal item is open to interpretation and that may have confounded the potential positive benefits of a performance approach goal, as varied interpretations across the sample could have self-cancelled the effect. This could be addressed in future revisions of the MMYC. Finally, the goal complex model would suggest that a pupil’s reason for their motivation would influence whether their performance goal would have adaptive educational outcomes (Senko & Tropiano, 2017). Given that these were not captured in the MMYC, the only reasonable comment that can be made in relation to this is that there would have be a substantially heterogenous constellation of ‘controlling reasons’ to generate consistently maladaptive effects.

There have been some substantial claims made about the potential of growth mindsets to have “profound” effects educational outcomes (e.g. Dweck, 2008). Contrary to this, others have presented data suggesting that there are limited effects of growth mindsets and interventions promoting them (e.g. Sisk et al., 2018). Many of the positive findings from recent reports suggest that a growth mindset is only beneficial to pupils who are at risk of academic underachievement (Blackwell et al., 2007; Claro et al., 2016; Paunesku et al., 2015; Yeager et al., 2019). The current research does not support the claim that growth mindsets have "profound" effects on educational outcomes, particularly for all pupils at risk of academic underperformance, indeed the current evidence is in places contrary to this. What the current evidence does highlight is that further research is needed to understand how particular groups respond to growth mindset messages and if growth mindsets are beneficial for particular tasks as opposed to others. It does show that the intervention led to modest learning gains for pupils. However, this may only be for certain types of tasks.

5. Intervention Evaluation - Teachers

5.1. Introduction

Most growth mindset interventions deliver their messages directly to pupils via the internet which means there is no involvement from teachers or schools, or often even external facilitators. Mindsets have been found to be highly sensitive; even small changes to language used when giving feedback can shape a pupil's mindset. Pupils are exposed to many different mindset messages, from parents, peers, teachers, and society. Considering the sensitivity of mindsets and the variety of messages which young children are exposed to, the Stoke Reads Mindset Kit aimed to engage educators as the delivery mechanism. The intervention was designed to help educators generate classroom cultures which promote growth mindsets, an educational environment which would buffer against any fixed mindset messages pupils may be exposed to.

The focus of this chapter is how educator engagement with the intervention may moderate its effectiveness. The Stoke Reads Mindset Kit was designed as a 'minimal resource' intervention with no prescription as to what extent educators were to use the suggested practices. It contained a variety of different ideas for educators to integrate into their existing practice. To fully evaluate the Mindset Kit, it was necessary to understand if particular elements were more effective at promoting a growth mindset than others. Additionally, if those elements had a dose-response threshold, i.e. if an element needed to be used to a certain frequency for it be effective. Previous research has suggested that a teacher's mindset does not necessarily influence their practice, but there is a dearth of literature exploring whether teachers' mindsets are altered by adopting a growth mindset pedagogical practices. Therefore, this chapter will also explore to what extent educators' mindsets were influenced by engaging with the Stoke Reads Mindset Kit.

The chapter will begin with a review of the literature exploring how teachers' mindsets can influence their students' mindsets. As pupil data are the same as utilised in Chapter 5 a presentation of participant information, materials, and procedure relating only to educators will be presented next. This chapter addresses the following two research questions:

- Research Question 4 – "How does teacher's engagement with the intervention and their own mindset influence the effectiveness of the intervention?"
- Research Question 5 – "Are teachers' mindsets influenced by using the intervention?"

As two research questions are addressed within this chapter which address the same data, joint methods and procedure sections will be presented. Following this, each research question will be addressed with separate results and discussion sections. The chapter will conclude with a general conclusion.

5.2. Background

Teachers, like all others, have their own personal mindset regarding their intelligence (Dweck, 2000). Researchers have suggested that a teacher's personal mindset does not necessarily influence their classroom practice, meaning that a teacher with a fixed mindset can effectively promote growth mindsets, and vice versa (Park, Gunderson, Tsukayama, Levine, & Beilock, 2016; Rattan, Good, & Dweck, 2012). Whilst there is a lack of research addressing how teachers may most effectively promote growth mindsets, there is cross-sectional research which suggests that teachers' achievement goals for teaching (i.e. if they have mastery or performance classrooms) and their belief in whether their pupils' intelligence can develop has a significant influence over pupils' educational outcomes (Shim, Cho, & Cassady, 2013). Beyond growth mindsets, pedagogical practices and teacher characteristics are highly predictive of pupil attainment, comparable with student background (Wenglinsky, 2002; Wright, Horn, & Sanders, 1997). If teacher's practices and attitudes have such substantial effects on pupil achievement and growth mindsets may benefit student achievement, there is a clear need for research addressing how teachers may promote growth mindsets.

Pedagogical practice in relation to mindsets is often categorised as either performance or mastery-oriented, promoting a fixed or growth mindset respectively (Kaplan, Gheen, & Midgley, 2002; Urdan & Midgley, 2003). Performance orientated practice focusses on student achievement; pupils are only rewarded when they have scored highly on a test, for example. Whereas, mastery orientated practice focusses on the learning process – celebrating increased understanding (Deemer, 2004). The primary goal of the Stoke Reads Mindset Kit was to provide teachers with tools to engage in mastery-orientated practice and generate a classroom culture that focusses on their pupils' learning as opposed to performance-orientated practice, celebrating achievement. It is predicted that these classroom cultures will foster growth mindsets in pupils. Therefore, it is important to understand how the Mindset Kit may interact with the various elements of the environment, such as, how teachers' personal mindsets, their pupils' mindsets, and how their pedagogical practices were influenced by engaging with the Stoke Reads Mindset Kit.

Despite the substantial body of evidence suggesting that teachers have a significant influence on their pupils' development (e.g. Hattie, 2003, 2008) there is limited research addressing the influence that teachers' pedagogical choices and their personal mindsets have on their pupils' mindsets. A notable exception is Park et al. (2016) who explored whether the mindsets of pupils aged six to eight years of age were influenced by their teacher's mindset. They concluded that a teacher's 'self' mindset (i.e. their views on the malleability of their own intelligence) was not predictive of either their pedagogical choices or their pupil's motivational frameworks. Their finding was in-line with previous research which found that teachers do not have to hold a particular mindset to promote it, which suggests that a teacher's self-mindset is separate from both their practice and does not influence their pupils' mindsets (Rattan et al., 2012).

Yet, Park et al. (2016) did find a relationship between teachers' personal mindsets and their practice, meaning that teachers who have a growth mindset are more likely to practice in mastery-orientated style. Park et al. (2016) utilised the Patterns of Adaptive Learning Scale (Midgley et al., 2005), this asks questions relating to mastery-orientated practice, or in other words, pedagogic choices allowing learning environments in which effort and practice can be rewarded (e.g., "I [teacher] give a wide range of math/reading assignments, matched to students' needs and skill level"). The opposing elements of the scale relates to performance-orientated practice, which promotes learning environments which celebrate test scores and demonstrating competence (e.g., "I [teacher] give special privileges to students who do the best work in math/reading").

Their study was conducted over one academic year and teachers' practices were found to be predictive of their pupils' mindsets at the end of the year, specifically they found teachers whose practice was performance orientated (i.e. on results as opposed to the learning process) promoted fixed mindsets. They reported a statistically meaningful, negative association between performance-orientated practices and pupil's achievement. Contrastingly, mastery orientated practice was not found to be predictive of pupil mindsets or achievement in any way. Park et al. (2016) attribute this finding to high levels of mastery orientated practice in early years settings (Midgley, Anderman, & Hicks, 1995). This led to higher means and reduced variance compared to fixed mindset orientated practice. Such findings do not necessarily preclude the utility of growth mindset practices, instead this suggests that classroom with a fixed mindset culture will negatively influence pupil achievement, and that a growth mindset culture may not necessarily promote pupil achievement.

In relation to pupil achievement Park et al. (2016) found that teacher's growth mindset practice was not predictive of pupil achievement. However, it is noteworthy that the intercepts are in the direction as would be expected and with a coefficient that would be comparable to effects found in other growth mindset interventions (Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018). Academic performance data were collected during the first three months of the school year and the last two months of the school year. Pupils were six to eight years of age and were tested using an age standardised maths test (Woodcock, McGrew, & Mather, 2001). The Woodcock-Johnson Tests of Achievement would have enough sensitivity to be a useful measure of pupil progression over a single academic year. Park et al. (2016) suggest that teacher's instructional practices may take more than one academic year to influence pupil achievement, their data suggest that mindsets relate to achievement and teachers do influence pupil motivation, which in turn predicts achievement. When accounting for pupils' initial maths achievement, pupils with an initial growth mindset achieved more in the end of year mathematics testing. This was also reflected when mindsets from the same time points were used to predict outcomes from the same time point, i.e. initial mindset predicted initial academic performance and end of year mindset predicted end of year academic performance. Whilst Park et al. (2016) could not fully establish links between teacher reported practices and achievement, the evidence suggested that it is worthy of further research.

There are several factors in Park et al. (2016) which warrant further exploration. Firstly, the wider school context was not taken into consideration, and whilst the individual teacher may report mastery orientated practice, the rest of the school could be highly performance as opposed to learning focussed. As discussed in earlier chapters, children do not exist in insolation in their classroom, and mindsets are highly sensitive, thus the wider school environment can influence pupil's psychology and achievement (Roeser & Midgley, 1996; Sammons, Gu, Day, & Ko, 2011). Secondly, results suggest that a mean of 35.6% of pupils in participating classrooms were recruited to the study. This is problematic, as it is an aggregate figure, there is no way to know if some classrooms had a bigger proportion of pupils recruited to the study than others. Those children not involved in the study may hold opposing mindsets to those who completed the study, making it hard to truly understand, or account for, the environment in the classroom. Finally, despite collecting socio-economic status data (household income), this data was not considered in their analyses. Research suggests that growth mindsets are most beneficial for pupils who are the most at risk of academic underperformance (e.g. Blackwell, Trzesniewski, & Dweck, 2007), or may have to overcome more challenging family circumstance (Claro, Paunesku, & Dweck, 2016). Overall, Park et al., (2016) provides statistically meaningful evidence that teachers goal orientation is predictive of their pupils' motivational orientation; performance practice promotes fixed mindsets. They did not find supportive evidence that teacher reported instructional practice was related to achievement.

Such findings are not unique to younger pupils, studies have explored how university educators shape their students' mindsets (Barger, 2019). This study followed university instructors, who were full faculty members, post-doctoral researchers, and graduate students, over six-week summer schools covering Psychology, Biology, and Statistics. Data were also collected from undergraduate students taking part in the summer school. The focus of the study was the feedback which instructors gave to both individual students and to whole classes, data were captured via audio recordings and coded.

University educators give less feedback compared to other educators and it is not usually praise (Mohd Meerah & Halim, 2011). The feedback they give is usually delivered during teaching elements of classes, or one-to-one and relates directly to assessments (Barger, 2019). There is some similarity between university and early years educators in the underlying messages they deliver to students, as they are both trying to develop learning behaviours. However, the words used are often very different. This is because University educators very rarely give direct behavioural feedback, the underlying messages the feedback conveys will be discussed below. Barger (2019) coded non-content messages into four categories:

1. *Instructor help*, e.g. "If you have questions, you can talk to me after class or email me."
2. *Differential ability*, e.g. "So, of course, thoughtful, intelligent people thinking about this would very quickly come up with the obvious question… why?"
3. *Conciliatory*, e.g. "Don't get hung up on things you don't know or don't understand"
4. *Uncertainty in the field,* e.g. "There's very little contact between the types of senses in the thalamus. Very, very little. In fact, for a long time, we thought there was none, and we're beginning to think that maybe, just maybe, there's a tiny little bit"

Results showed that students in classes in which the instructor made more *instructor help* or *conciliatory* messages were more likely to have a fixed mindset. This shows that mindsets can be encouraged via feedback, without process or person praise more commonly seen (e.g. "You worked really hard at this"). The messages conveyed are more subtle, for example, an *instructor help* phrase such as "Ask me for help if you don't understand". It may represent a stigma about not knowing, or implicit lack of ability, or that the student will require tutor support to understand the concept as opposed to being able to gain understanding on their own. Such messages would promote a fixed mindset. This does raise the question of different forms of feedback within early years classrooms too as not all feedback is delivered upon a piece of work being completed, or skill additional. Overall, similarly to Park et al. (2016) it was found that instructor's mindsets did not influence the effectiveness of their practice, meaning that instructors with a fixed mindset could effectively promote growth mindsets and vice versa.

The wider literature shows the substantial influence teachers have over pupil and student achievement (Hattie, 2003). Yet, many contemporary interventions are based around content delivered over the internet (e.g. Paunesku et al., 2015; Yeager et al., 2019). What the above studies show, is how teachers can develop growth mindset within their pupils. However, there is a dearth of research which has addressed solutions to educating teachers in practices which promote growth mindsets. There are a great many factors to consider in assessing how educators promote growth mindsets (Barger, 2019; Park et al., 2016). In addition, there are a great many factors to consider in respect of a changing educational landscape, particularly within the UK context in respect of funding arrangements (Andrews & Lawrence, 2018). As the intervention was designed to form part of the 'legacy' of the Stoke Reads programme the trial took place with no involvement from the researcher. In doing so the trial became a test of how effective the intervention would be following the end of the research. This was important as the intervention would be available for educators to download with no provision for continued training and support within the City, or indeed, further afield. With the trial being deliberately non-prescriptive it was essential to capture which elements of the toolkit teachers used. This allowed an investigation into whether certain elements of the intervention were particularly effective, for example should one teacher have only opted to utilise verbal feedback did they influence their pupil's mindset compared to a teacher who delivered all elements of the intervention.

5.3. Method

Pupil data is the same as reported in Chapter 5. Therefore, the participants and materials outlined below are only in reference to the teacher elements.

5.3.1. Participants

At Time 1 there were 12 educators recruited, and 5 completed the post-test materials. No further demographic information was collected. It was most important that teachers felt completely anonymous and responded as honestly as possible as growth mindsets have a certain degree of social desirability (Hong, Chiu, Dweck, Lin, & Wan, 1999).

5.3.2. Materials

5.3.2.1. General survey

The first section requested the individual's anonymous code and their role (teacher or teaching assistant). To capture the classroom and school culture, the Patterns of Adaptive Learning Survey (PALS) (Midgley et al., 2005) was used. All sections from PALS utilise a five-point response format, 1 = "Not at all true", 3 = "Somewhat true", and 5 = "Very true". Participants could indicate their response using a five-point slider. The first instrument from PALS measured educator's perception of the mastery culture in their school:

1. "In this school the importance of trying hard is stressed to pupils"
2. "In this school pupils are told that making mistakes is OK as long as they are learning and improving"
3. "In this school a lot of the work pupils do is boring and repetitious" (reversed)
4. "In this school pupils are frequently told that learning should be fun"
5. "In this school the emphasis is on really understanding school work, not just memorising it"
6. "In this school a real effort is made to recognise pupils for effort and improvement"
7. "In this school a real effort is made to show pupils how the work they do in school is related to their lives outside of school"

The second instrument taken from PALS measured educator's perception of the performance culture in their school (all reverse coded so higher scores equal a higher growth mindset culture):

8. "In this school it's easy to tell which pupils get the highest grades and which students get the lowest grades"
9. "In this school pupils who get good grades are pointed out as examples to others"

10. “In this school pupils hear a lot about the importance of getting high test scores”
11. “In this school grades and test scores are not talked about”
12. “In this school pupils hear a lot about the importance of getting high test scores”

The third instrument taken from PALS explored the any mastery approaches that teachers used in their classrooms. Some of these items were adapted to make them appropriate to the UK context. For example, Question 13:

13. “I make a special effort to recognize students’ individual progress, even if they are performing below where I would expect them to”
14. “During class, I often provide several different activities so that students can choose among them”
15. “I consider how much students have improved when I give them grades”
16. “I give a wider range of assignments, matched to students’ needs and skill level”

Often the targeted subject of the instrument is adapted, whilst retaining the majority of items, the self-theories instrument (Dweck, 2000) was adapted in this way. Participants used the same response format as on the self-form (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Strongly disagree) to respond to the following statements:

17. “There isn’t much I can do to make my pupils smarter as their abilities are fixed at birth”
18. “My pupils intelligence is something which they can’t change very much”

19. “My pupils can learn new things, but they can’t really change their basic intelligence”

The final instrument taken from PALS explored how effective teachers considered their own practice to be:

20. “If I try really hard, I can get through to even the most difficult pupil”
21. “Factors beyond my control have a greater influence on my pupils’ achievement than I do”
22. “I am good at helping all the pupils in my classes make significant improvement”
23. “Some pupils are not going to make a lot of progress this year, no matter what I do”
24. “I am certain that I am making a difference in the lives of my pupils”
25. “There is little I can do to ensure that all my pupils make significant progress this year”
26. “I can deal with almost any learning problem”

To capture participant’s theory of intelligence for themselves (i.e. whether they believe their own intelligence is malleable), was done using the “Theories of Intelligence Scale – Self Form for Adults” (Dweck, 2000). Participants rated their agreement using a Likert-style response format (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Strongly disagree) on the following statements:

27. “You have a certain amount of intelligence and you really can’t do much to change it”

28. “Your intelligence is something about you that you can’t change very much”
29. “You can learn new things, but you can’t really change your basic intelligence”

5.3.2.2. Intervention feedback

At Time 2, in addition to the general teacher survey, teachers in the experimental condition also completed questions regarding their use and views of the Stoke Reads Mindset Kit. This was added on as part of the general survey. The first section asked teachers “How often have you used the following elements of the Mindset Kit?”. The sections were listed as: verbal feedback, written feedback, music lessons, mindset books, focused practice, class dojo, progress displays, class mindset discussions. Teachers were given a five-point response scale to indicate their use of each of the elements: 1 = always, 2 = most of the time, 3 = a few times, 4 = once, 5 = never.

The second section covered utilised a six-point response scale (1 = Strongly agree, 2 = Agree, 3 = Mostly agree, 4 = Mostly disagree, 5 = Disagree, 6 = Mostly disagree) and asked teachers about their views on the Stoke Reads Mindset Kit and whether they felt having a growth mindset is useful for their pupils:

1. I found the Mindset Kit useful
2. I would recommend the Mindset Kit to a colleague
3. The Mindset Kit has been beneficial in my classroom
4. I believe having a growth mindset helps my pupils learn

5. The Mindset Kit has a good range of activities
6. The activities in the Mindset Kit are appropriate for Year 1 pupils
7. The layout of the Mindset Kit is accessible
8. The Mindset Kit is a good introduction to mindsets for teachers

5.3.2.3. Intervention

The intervention was professionally printed in a 'glossy' format, this was considered an important design feature so that the intervention would appear as credible as possible and therefore encourage meaningful engagement from teachers. Copies of the intervention were posted to teachers. There were no specific instructions as to how to utilise the intervention, teachers were encouraged to integrate it into their own practice, the intervention is laid out in detail in Chapter 3 – Intervention Development and can be seen in full in Appendix M.

5.3.3. Procedure

5.3.3.1 Consent

Ethical approval was gained from Keele University, please see Appendix K**.** Initially Head Teachers were contacted to seek their approval for the research to take place in their schools, this included both teachers and pupils, see Appendix O. Teachers were then contacted directly via e-mail inviting them to participate in the study. Attached to the email was the information and consent forms (see Appendix Q)**.** Please see below for details of the anonymisation protocol employed.

5.3.3.2 Data collection and anonymisation

The survey was hosted online, and teachers and teaching assistants were e-mailed links via Stoke Reads. A two-week window was set on the survey to ensure pre-test data were collected before the intervention was released. The same procedure was adopted post-test and teachers who were part of the experimental group were e-mailed a link to a survey which included the extra questions regarding the Mindset Kit.

Stoke Reads held a list of anonymous codes for each educator involved in the project. The researcher prepared a template e-mail which Stoke Reads distributed to educators that included their anonymous codes.

5.5. Results

Results in this section address the research question - "How does teachers engagement with the intervention and their own mindset influence the effectiveness of the intervention?". Descriptive statistics are presented in Table 38 below. Only the experimental group are listed at Time 1 as the five educators who responded at Time 1 were all from this group. Higher scores denote higher use of the elements.

Table 38.
Descriptive statistics for frequency of use of toolkit elements. Time 1 only.

	N	Mean	SD	Low 95% CI	High 95% CI
Verbal feedback					
	5	1.40	0.55	0.92	1.88
Written Feedback					
	5	2.00	1.00	1.12	2.88
Music lessons					
	5	3.40	1.67	1.93	4.87
Mindset books					
	5	3.80	1.10	2.84	4.76
Focussed practice					
	5	2.80	1.30	1.66	3.94
Class Dojo					
	5	2.60	2.19	0.68	4.52
Progress displays					
	5	3.60	1.34	2.42	4.78
Class discussions					
	5	2.80	0.45	2.41	3.19

This question asks whether how often they used the different elements influenced how effectively it promoted growth mindsets. For example, did a 'single dose' of music lessons produce growth mindsets. Additionally, it also asks whether school culture or teacher's mindset beliefs influence how effective the intervention was. Analyses will be presented in this order.

Data were analysed using multilevel modelling which allowed for a multiple-regression based modelling accounting for the variance from each different activity with the Stoke Reads Mindset Kit to be attributed to the difference between items, whilst accounting for the influence of clustering by school. Null models were compared to those with grouping by school using leave-one-out cross-validation and models without clustering were found to fit data better. Flat multiple regression models were specified with the MMYC item from Time 1 as the outcome variable, and the Time 0 item as a predictor along with all of the Mindset Kit activities. Unfortunately, these models would not converge within BRMS (Bürkner, 2017), this is likely due to the small amount of data (i.e. K=4 groups) which resulted in multicollinearity and insufficient variance to allow the sampling algorithm to separate out the contribution from each predictor (Gelman & Rubin, 2007; Kruschke, 2015).

Therefore, to gain the most detail from the available data, univariate as opposed to multivariate models were constructed: outcome variable was specified as the Time 1 item from the MMYC, the uptake of Mindset Kit element as the predictor, and the Time 0 item from the MMYC was entered as the co-variate. This was completed for each combination of MMYC item and each Mindset Kit activity individually. One advantage of this approach is access to the estimates for each level of uptake, which allows for a detailed investigation into the dose-response relationship, these are presented below in Table 39. Results may be considered statistically relevant if 0 is not included as part of the credible intervals range (CIs) (Gelman & Hill, 2007; Kruschke, 2015; McElreath, 2016). Should the credible interval range include zero, but the estimate error be greater than the difference from the zero to the upper or lower bound then this suggests that there may be a relationship which was not fully uncovered or supported by current data (Krushke, 2015). To highlight the differences in these relationships and to ease interpretation of large tables any relationships which do not have zero in the credible interval bounds will be highlighted with a double asterisk symbol (**) and those which the estimate error is greater than the difference from zero to the upper or lower bound will be highlighted with a single asterisk (*). Results without any asterisk symbols were not found to be statistically meaningful. This approach of highlighting meaningful results will be adopted across all results tables where appropriate. Teachers use of the different elements was captured on a 1-5 scale (1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always), this is labelled in Table 39 on the first left hand column.

Table 39.
Regression results for frequency of teacher uptake of Mindset Kit elements predicting change in pupils MMYC responses.

Verbal Feedback

	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)			
	Mean	SD	L95% CI	U95% CI		Mean	SD	L95%CI	U95%CI		Mean	SD	L95%CI	U95%CI
1														
2														
3														
4	-0.28	0.18	-0.66	0.08	*	-0.32	0.20	-0.72	0.07	*	-0.31	0.16	-0.64	0.01
5	0.28	0.18	-0.08	0.65	*	0.32	0.20	-0.08	0.71	*	0.31	0.16	-0.01	0.64

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)			
	Mean	SD	L95%CI	U95%CI		Mean	SD	L95%CI	U95%CI		Mean	SD	L95%CI	U95%CI
1														
2														
3														
4	-0.37	0.17	-0.71	-0.04	*	-0.14	0.11	-0.37	0.07	*	0.20	0.21	-0.22	63.00
5	0.37	0.17	0.04	0.71	**	0.14	0.11	-0.07	0.36	*	-0.20	0.21	-0.63	0.22

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)			
	Mean	SD	L95%CI	U95%CI		Mean	SD	L95%CI	U95%CI		Mean	SD	L95%CI	U95%CI
1														
2														
3														
4	-0.13	0.49	-1.06	0.83		-0.80	0.47	-1.72	0.10	*	0.31	0.60	-0.81	1.56
5	-0.57	0.28	-1.10	0.00	*	0.51	0.35	-0.16	1.16	*	0.78	0.45	-0.17	1.63

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Written Feedback

	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2															
3	3.00	0.17	-0.22	0.47		-0.05	0.18	-0.42	0.31		0.25	0.15	-0.04	0.55	*
4	-0.13	0.17	-0.47	0.22		0.05	0.18	-0.31	0.42		-0.25	0.15	-0.55	0.04	*
5															

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2															
3	-0.27	0.14	-0.55	0.01	*	0.10	0.09	-0.09	0.29		1.05	0.18	0.70	1.41	
4	0.27	0.14	-0.01	0.55	*	-0.10	0.09	-0.29	0.09		-1.05	0.18	-1.41	-0.70	
5															

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2															
3	-0.02	0.42	-0.82	0.83		-0.44	0.42	-1.32	0.35	*	-0.38	0.50	-1.38	0.56	
4	-0.58	0.33	-1.20	0.09	*	0.61	0.44	-0.26	1.47	*	1.05	0.52	0.07	2.09	**
5															

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Music															
	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.14	0.21	-0.57	0.28		0.08	0.23	-0.37	0.55		-0.28	0.19	-0.65	0.10	*
3	-0.37	0.24	-0.86	0.09	*	-0.39	0.25	-0.91	0.10	*	-0.40	0.21	-0.82	0.00	*
4															
5	0.52	0.23	0.06	0.98	*	0.31	0.24	-0.17	0.79	*	0.68	0.20	0.29	1.08	**

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	0.36	0.18	-0.01	0.72	*	-0.10	0.12	-0.35	0.14		-1.34	0.24	-1.82	-0.87	**
3	-0.45	0.22	-0.89	-0.03	**	-0.20	0.14	-0.48	0.08	*	0.36	0.25	-0.15	0.86	*
4															
5	0.09	0.19	-0.30	0.47		0.3	0.13	0.04	0.57	**	0.98	0.24	0.51	1.46	**

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.58	0.32	-1.19	0.06	*	0.57	0.44	-0.26	1.47	*	1.04	0.52	0.08	2.09	
3	-0.15	0.52	-1.15	0.86	*	-0.86	0.52	-1.92	0.13	*	0.00	0.65	-1.30	1.20	
4															
5	0.03	0.47	-0.84	0.99		-0.12	0.50	-1.07	0.90		-0.60	0.55	-1.68	0.46	

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Books															
	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2															
3	-0.37	0.24	-0.85	0.09	*	-0.39	0.25	-0.91	0.11	*	-0.40	0.20	-0.82	0.00	**
4	-0.15	0.21	-0.57	0.28		0.08	0.23	-0.38	0.55		-0.28	0.19	-0.64	0.09	*
5	0.52	0.23	0.06	0.98	**	0.31	0.24	-0.17	0.90	*	0.68	0.20	0.29	1.07	**

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2															
3	-0.45	0.22	-0.89	-0.03	**	-0.19	0.14	-0.48	0.08	*	0.36	0.25	-0.14	0.86	*
4	0.36	0.18	0.00	0.74	**	-0.10	0.12	-0.34	0.14		-1.34	0.24	-1.82	-0.88	**
5	0.08	0.19	0.30	0.48	**	0.3	0.13	0.04	0.57	**	0.99	0.24	0.51	1.46	**

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2															
3	-0.70	0.46	-1.56	0.24	*	-0.29	0.51	-1.32	0.67		1.05	0.65	-0.18	2.35	*
4	0.12	0.51	-0.88	1.09		0.85	0.52	-0.18	1.82	*	-0.02	0.64	-1.24	1.27	
5	0.16	0.54	-0.92	1.21		0.75	0.55	-0.31	1.82	*	-0.60	0.64	-1.96	0.56	

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Focussed practice															
	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.15	0.21	-0.58	0.29		0.08	0.23	-0.37	0.54		-0.27	0.19	-0.65	0.10	*
3	-0.37	0.24	-0.85	0.10	*	-0.39	0.26	-0.91	0.10	*	-0.40	0.21	-0.82	0.01	*
4						0.31	0.24	-0.17	0.79	*	0.68	0.20	0.28	1.07	**
5	0.52	0.23	0.06	0.98	**										
	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	0.36	0.19	0.00	0.74	**	-0.10	0.12	-0.35	0.14		-1.34	0.23	-1.82	-0.88	**
3	-0.44	0.22	-0.89	-0.02	**	-0.20	0.14	-0.48	0.08	*	0.36	0.25	-0.15	0.85	*
4															
5	0.08	0.19	-0.31	0.47		0.3	0.13	0.04	0.57	**	0.99	0.24	0.52	1.45	**
	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.58	0.32	-1.19	0.06	*	0.57	0.44	-0.26	1.45	*	1.04	0.52	0.08	2.09	**
3	-0.15	0.52	-1.15	0.86		-0.86	0.52	-1.92	0.13	*	0.00	0.65	-1.30	1.20	
4															
5	0.03	0.47	-0.84	0.99		-0.12	0.50	-1.07	0.90		-0.595	0.55	-1.68	0.46	*

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Dojo

	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1	0.13	0.17	-0.22	0.47		-0.06	0.18	-0.43	0.30		0.28	0.13	-0.04	0.54	*
2															
3															
4															
5	-0.13	0.17	-0.47	0.39		0.06	0.18	-0.31	0.43		-0.25	0.15	-0.32	0.04	*

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1	-0.26	0.13	-0.55	0.01	*	0.10	0.09	-0.09	0.29	*	1.05	0.18	0.70	1.41	**
2															
3															
4															
5	0.26	0.14	-0.02	0.54	*	-0.1	0.09	-0.29	0.08	*	-1.05	0.18	-1.41	-0.70	

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1	-0.61	0.36	-1.31	0.08	*	0.17	0.38	-0.57	0.91		0.68	0.48	-0.24	1.64	*
2															
3															
4															
5	0.03	0.42	-0.76	0.88		0.45	0.44	-0.44	1.29	*	0.36	0.48	-0.58	0.13	

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Displays

	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.37	0.24	-0.86	0.09	*	-0.39	0.25	-0.91	0.11	*	-0.40	0.21	-0.82	0.00	**
3	-0.15	0.21	-0.58	0.28		0.08	0.24	-0.37	0.55		-0.28	0.19	-0.65	0.10	*
4															
5	0.52	0.23	-0.10	0.34	*	0.31	0.24	-0.17	0.79	*	0.68	0.20	0.29	1.07	**

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.45	0.22	-0.89	-0.02	*	-0.19	0.14	-0.48	0.09	*	0.36	0.25	-0.14	0.86	*
3	0.36	0.18	0.00	0.73	**	-0.11	0.12	-0.36	0.13		-1.34	0.24	-1.82	-0.87	**
4															
5	0.09	0.20	-0.31	0.48		0.3	0.13	0.04	0.57	**	0.98	0.24	0.51	1.46	**

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.70	0.46	-1.56	0.24	*	-0.29	0.51	-1.32	0.67		1.05	0.65	-0.18	2.35	*
3	0.12	0.51	-0.88	1.09		0.85	0.52	-0.18	1.82	*	-0.02	0.64	-1.24	1.27	
4															
5	0.16	0.54	-0.92	1.21		0.75	0.55	-0.31	1.82	*	-0.599	0.64	-1.96	0.56	

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

Discussions

	Performance Goals (Q1)					Learning Goals (Q2)					Failure - Affective (Q3)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.28	0.18	-0.66	0.07	*	-0.32	0.20	-0.72	0.07	*	-0.31	0.16	-0.64	0.01	*
3	0.28	0.18	-0.08	0.65	*	0.32	0.20	-0.08	0.72	*	0.31	0.16	-0.02	0.64	*
4															
5															

	Failure - Persistence (Q4)					Success - Affect (Q5)					Success - Persistence (Q6)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.37	0.17	-0.71	-0.04	*	-0.14	0.11	-0.37	0.07	*	0.20	0.22	-0.22	0.64	
3	0.37	0.17	0.04	0.71	*	0.14	0.11	-0.07	0.36	*	-0.20	0.22	-0.64	0.22	
4															
5															

	Essentialism (Q8)					Mindset - Others (Q9)					Mindset - Self (Q10)				
	M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI		M	SD	L95%CI	U95%CI	
1															
2	-0.72	0.48	-1.65	0.19	*	-0.29	0.53	-1.33	0.72		1.10	0.64	-0.11	2.34	*
3	0.15	0.49	-0.79	1.08		0.79	0.49	-0.19	1.73	*	-0.30	0.58	-1.35	0.89	
4															
5															

Note. 1 = Never, 2 = Once, 3 = A few times, 4 = Most of the time, 5 = Always.

The current research question asks whether the amount a teacher has used particular elements of the Mindset Kit changes how effective it was. In other words, was there a dose response mechanism that substantially alters outcomes. Therefore, the data will be considered in respect of each element of the Mindset Kit (e.g. verbal feedback, music lessons, books) and how the uptake of these changed pupils' mindsets over one year. As highlighted above the quantity of groups is small (K=4). Whilst caution must be applied in generalising these results as there are only a small number of groups, the quantity of pupils in the sample and the analysis strategy which was adopted provides a detailed view of the current research.

Verbal feedback will be the first element to be assessed. All schools implemented this either always or most of the time and what is most striking is the almost opposite results for the majority of MMYC items between the two levels of uptake. For performance goals, learning goals, affective response to failure, persistence following failure, affect following success, other mindset, and self-mindset using process praise all of time resulted in increases in growth mindset for pupils. When educators used verbal feedback consistently (i.e. "all of time") the was a positive and statistically meaningful increase in the majority of MMYC items. However, this is contrasted by the almost opposite results when verbal feedback was used less consistently by educators who reported using it "most of the time". In this category of uptake, the same quantity of MMYC items had a statistically meaningful relationship with uptake, but the relationship was negative. This suggests that verbal feedback is an effective mechanism to promote growth mindsets when used consistently.

Written feedback had a very limited influence on pupils' mindsets compared to verbal feedback. Educators only reported using written feedback "most of the time" or "some of the time". More consistent use (i.e. "most of the time" as opposed to "some of the time") of written feedback created a less positive affective response to failure, whereas a more positive affective response to failure was found for pupils whose teachers used written feedback "some of the time". Whereas, the opposite was true for pupils persistence following failure. Written feedback was effective in promoting both self and other-growth mindsets when educators did so "most of the time". However, there was no statistically meaningful relationship between written feedback and MMYC items when educators implemented it "some of the time".

Recording progress during music lessons and highlighting the progress that pupils had made seemed to be detrimental to the majority of MMYC proximal learning behaviours (i.e. not implicit theory of intelligence items). The most secure evidence was found for not using this approach. However, it is worth noting that the school who utilised it consistently (i.e. "always") increased persistence following failure, but this is contradicted by the persistence following success findings. These items are coded so that an increase denotes a growth mindset. Additionally, as would be hypothesised this approach increased growth mindsets (both self and other) and schools who did not implement this approach at all had pupils with more of a fixed mindset.

Using books during class reading sessions which contain a growth mindset story showed somewhat conflicting results. When teachers utilised these books "all of the time" the majority of results were positive, at least for the MMYC items which had a statistical meaningful relationship with their use. However, as teachers used them less frequently in the "most of the time" or "a few times" categories results were either inconclusive or negative. Books were a positive mechanism to promote more growth mindset views of others (Question 9). However, the only statistically meaningful relationship with self-mindset (Question 10) was in the classroom in which books were used "a few times". This suggests that there may be significant variability between the effect of the individual books chosen by teachers.

The majority of non-implicit theory measures were not improved through the use of focussed practice. However, there was substantial evidence to suggest that regular use of the technique "most of the time" generated a more positive affective response to failure. Yet there are opposite findings to response to success, both affective and persistence. Particularly noteworthy, is the substantial evidence suggesting that the school which used focussed practice the most frequently had pupils with a reduced persistence following success. The success items are scored such that they should mirror the failure items. However, there was also substantial evidence suggesting that not using focussed practice also increased pupils' persistence following failure. Focussed practice also had a positive impact on the mindset self and other questions, with the school who did not use focussed practice having comparatively reduced growth mindsets.

The use of a token reward system (Class Dojo) had generally favourable results. It is unsurprising that there was no influence of this on performance and learning goals, as it would be impossible for teachers to reward these behaviours directly. However, rewarding explicit behaviours such as a positive affective response to failure does work. Yet it would appear that it is not effective at generating persistence following failure. Although, there was substantial evidence that it can increase persistence following success, which as mentioned above should mirror response to failure results. Overall it appeared that token reward systems were negative towards promoting other growth mindsets. But there was some evidence that they promote self-growth mindsets.

Overall, as with most elements from the Mindset Kit, frequency influenced whether the results were positive or negative. When educators used progress displays “all of the time” results were positive, whereas when utilised “once” results were mostly negative. But there was not a consistent pattern in the results; different elements and different use rates had different influences on the MMYC items. However, there were some suggestions that progress displays may promote persistence, as both persistence following failure and success were increased. These findings should be treated with caution as the school which utilised progress displays the most (“most of the time”) had negative results and when used “a few times” results were substantially positive. But the reverse is true for persistence following success. Results do suggest that progress displays could be a mechanism for promoting implicit theories of intelligence, as positive results were found. But in respect of other mindsets not using the progress displays was also beneficial.

Overall, class discussions had a negative effect. As the schools which used them "most of the time" had negative results, whereas the school which utilised them "a few times" had positive results. This juxtaposition would perhaps suggest that the teachers who delivered the discussions were perhaps not all equal in their ability to stimulate the right conversations. In relation to implicit theories, data suggests that for both self and other mindsets that discussions are an effective tool for promoting these ideas.

Finally, there was no substantial evidence that any of the techniques promoted a more growth mindset perspective on essentialism. Indeed, the evidence uncovered suggests that all the exercises promote essentialist views.

5.6. Discussion

This discussion addresses the research question - "How does teacher's engagement with the intervention and their own mindset influence the effectiveness of the intervention?". The findings of this study must be considered with several caveats. Primarily, the sample size is small ($K_{schools} = 4$, $N_{teachers} = 5$) which not only limits the generalisability of the results but also does not provide a broad spectrum of uptake within the sample; teachers were free to use, or not, any element of the Mindset Kit they wished. This means that for many Mindset Kit activities only two 'categories' of uptake were identified. Whilst this may temper the conclusions drawn there are some interesting patterns within data which are worthy of consideration. However, the sample did include every school within the experimental condition. As every activity within the Mindset Kit was assessed for its influence on every item from the MMYC, the influence of each activity will be considered in the same sequence as the results are presented above and finishing with a more general conclusion.

Process praise has been shown to promote a growth mindset, both in the short term within a single experiment (Haimovitz & Corpus, 2011; Kamins & Dweck, 1999), and across the longer term over a period of several years (Gunderson et al., 2018). The current findings suggest that process praise is an effective way of promoting all elements of a growth mindset. However, the current findings also reveal that it is critically important for process praise to be used consistently as results from teachers who utilised it "always" promoted growth mindsets, whereas teachers who used it "most of the time" promoted fixed mindsets. The Stoke Reads Mindset Kit does include caveats that praise should be contingent, specific, and genuine (Henderlong & Lepper, 2002), with the intention that teachers would avoid going on a 'praise binge' (Dweck, 2015). But data were not collected as to whether teachers followed these guidelines; it is the intention rather than fact. There is limited research which has explored the dose-response relationship for process praise. Gunderson et al. (2018) coded praise between parent child dyads during 90-minute observations, they found that overall parents provided 18% (SD = 16.3%) process praise to their children which was subsequently found to be predictive of children's fourth grade motivational framework and mathematics achievement. This suggests that even a small amount of process praise can be substantially predictive of later mindset and achievement. Additionally, there is a dearth of research exploring how long a growth mindset will be maintained. Donohoe, Topping and Hannah (2012) found that after utilising the Brainology programme (a computer-based game designed to promote growth mindsets) that the growth mindset had faded after three months. Mindsets are highly susceptible to change, indeed, subtle changes in language have been shown to rapidly promote a growth or fixed mindset (Cimpian, Arce, Markman, & Dweck, 2007; Skipper & Douglas, 2012). The current results, in addition to findings by Gunderson et al. (2018), would suggest that consistent use of process praise is an effective mechanism to generate and maintain growth mindsets within pupils. It could also be that teachers who did not use praise as frequently slipped into comforting praise such as “not everyone can be good at reading”; feedback such as this has been shown to promote fixed mindsets (Rattan, Good, & Dweck, 2012).

There are some findings which suggest that consistent use of written feedback can also effectively promote growth mindset. Results for self-mindset are statistically meaningful and suggest a substantial increase in growth mindsets. Additionally, there was some evidence that written feedback may also promote a more growth other-mindset but this evidence was not as clear as self-mindset. Whilst there is limited prior evidence available regarding how written feedback may promote growth mindsets, the Mindset Kit included a selection of feedback ‘stickers’ (see Appendix M). These were based on process praise phrases suggested by Cimpian, Arce, Markman, and Dweck (2007), for example “You have learnt from your mistakes”. The current results suggest that: written process praise was as effective as verbal process praise in promoting persistence following failure, but the consistent use of a written feedback produced a more negative affective response following failure. This is contrary to findings by

Skipper and Douglas (2012) who found that person praise produced negative affective responses to failure, but process praise did not change participant's affective response to failure compared to a control group who received objective feedback (e.g. "You got 5 out of 5 correct"). However, the current results suggested that written feedback generates more persistence following failure. A total of sixteen written feedback stickers were produced, and none of them were necessarily targeted for use following a failure. It may be that, independent of a failure, the stickers were an effective way to promote a growth mindset. It is this growth mindset which in turn develops persistence following a failure as opposed to the sticker directly providing a behavioural direction (e.g. "Keep going, we can all develop how clever we are!").

The act of recording pupils during music lessons and highlighting the progress which they made had an overall negative effect on their learning behaviours, but a positive one on their mindset (implicit theory of intelligence). One of the strongest and most robust findings for the music activity was the reduction in persistence following success. Growth mindsets have been shown to be domain specific, meaning pupils can have different mindsets in different subject areas (Lou & Noels, 2016; Scott & Ghinea, 2014). Within the school which used this technique "all of the time" the focus became pupil's musical development. With the focus on development and learning, once a pupil had achieved the skills there may be a lack of motivation to continue developing as the focus was on the learning process. Without differentiation and a clear pathway to progress beyond the learning objectives of each lesson, pupils may have a ceiling effect in music. Recent research suggests that music lessons have been "squeezed out" out of UK schools due to pressures on the curriculum teachers are more likely to have single and independent music lessons without learning pathways for pupils to take once they have mastered the techniques in the current lesson (Savage & Barnard, 2019). This suggests that educators wishing to have growth mindset cultures in their classrooms should ensure that pupils are able to pursue learning to its fullest extent.

Similarly, to music lessons, books, were a useful element of the Mindset Kit for promoting growth mindsets, but generally negative for learning behaviours. However, they did encourage persistence following failure. Before considering why this may be the case it is important to recognise that books were in fact the least utilised activity with the most frequent use being “a couple of times”. This is probably because teachers are under significant pressure to develop pupils reading abilities, therefore, pupils are required to read banded phonically decodable texts, leaving little time for reading optional texts such as the ones suggested. Despite the relatively small ‘dose’ of the books, they still produced statistically robust and striking increases in negative responses to failure. This is particularly surprising as the books chosen had very positive messages about persistence following failure, which is somewhat supported by the increases in persistence following failure. There are examples in the literature where stories have successfully promoted growth mindsets, in which donkeys were used as a metaphor for perseverance; the donkey kept going despite challenges (Cacciamani, 2016). The stories selected in the Mindset Kit did not utilise metaphor but were direct stories of characters overcoming challenges. It is possible that children were unable to place themselves within the story and therefore did not understand the messages as they were directly communicated.

Focussed practice had limited effects on all MMYC learning behaviour items, except for persistence following failure and success. These results were contradictory; persistence following failure increased and persistence following success decreased. Indeed, the most positive increases in self-mindset were to be found in the schools which utilised focussed practice the least. The contradictory results regarding persistence are best understood in the context of the activity itself. Classes were given dedicated time to develop a skill, during which they would make mistakes, at the end of the focussed practice period their learning process (including mistakes) would be celebrated. It is this element of focussed practice which likely generated more positive responses to failure. However, activities set by teachers may not allow pupils to 'succeed' as they were encouraged to set focussed practice sessions on skills such as drawing. In doing so, pupils are not necessarily reaching a concrete end point in their skill development. This could reduce their persistence following success as it would not provide them with comparable opportunities to experience success in a positive way. It may be that focussed practice sessions should have a goal agreed between pupil and teacher to provide this sense of completion. Recent suggestions concerning how constructing learning environments which allow pupils to experience failures may increase learning (Kapur, 2016). Yet responses to failure are only a part of the self-theories framework (Dweck, 2000). The null results in relation to learning and performance goals suggests that the tasks which teachers set for pupils were understood by pupils more as skill development rather than a challenging learning opportunity. However, focussed practice was a positive way to promote incremental theories of intelligence for both the self and others. What this highlighted is how even one technique can have differing influences across the implicit theories framework.

Schools either used Class Dojo consistently (i.e. "all the time") or never, thus providing a more robust comparison of the effects of its use. Overall, results were mixed but using Class Dojo to reward growth mindset behaviours and attitudes increased persistence following failure and promoted other-growth mindsets. This is in direct contrast to the findings of Deci, Ryan, and Koestner (1999) whose meta-analysis found that extrinsic rewards undermined intrinsic motivation. However, despite the many contingent reward structures that Deci, Ryan, and Koestner (1999) outline there is not a category which captures the concept of rewarding a pupil for displaying positive learning behaviours directly. Rather, their notion of extrinsic rewards are as inherent motivators, in that the pupil would seek the reward for completing or engaging with the task. Whereas extrinsic reward (token reward systems) are applied in the MMYC to reward intrinsic behaviours. Therefore, this may be why the current results are contrasting to Deci, Ryan, and Koestner (1999). It is not surprising that Class Dojo did not have any association with self-mindset as it would not be possible for teachers to reward a pupil's mindset directly. This would suggest that the relationship between mindset and learning behaviours is unidirectional, as increasing associated behaviours does not increase growth mindset. This is in-line with extant models of the self-theories framework which places implicit theory as the originating variable with a unidirectional path out from implicit theories (Blackwell et al., 2007; Dupeyrat & Mariné, 2005). However, what it does suggest is that interventions can develop behaviours and cognitions associated with a growth mindset without directly promoting an implicit theory of intelligence.

The use of progress displays was negative for the schools who used them the most. The strongest and most robust positive relationship was found for schools who did not use progress displays. However, the evidence is somewhat mixed as persistence following success increased when progress displays were used "most of the time" and substantially reduced when they were used "a few times"; with the opposite true for persistence following failure. Progress displays were designed to provide a consistent reminder to pupils that the most important part of their time in school is the learning which takes places and that it is a messy process. However, it is possible that a display exemplifying the messy, mistake filled nature of learning is not as aspirational to pupils. They may find a display of their 'best' work as aspirational and whilst they are going through the learning process it could serve to buffer their self-esteem and thus their academic self-concept (Koole & DeHart, 2011).

Finally, the use of discussions seemed to have somewhat contradictory results as the two categories of uptake are opposite to each other across all MMYC items except for the final three questions. This is likely a statistical artefact, which is hard to discern given the current sample size. However, it raises the question that discussions are the least prescribed element of the Mindset Kit. Teachers were entirely responsible for guiding a whole class discussion around growth mindsets, the evidence, as it is, suggests that the quality of the discussion is more important than the quantity of them. Dweck (2015) has highlighted her concerns about teachers misinterpreting the self-theories framework and creating a 'false growth mindset'. The results from class discussions suggest that educators may require much more instruction than was provided in the Mindset Kit to be able to hold classroom discussions which effectively promote growth mindsets.

5.7. Results

The results below address the research question - "Are teachers' mindsets influenced by using the intervention?". Descriptive statistics are presented in Table 40 below.

In addition to exploring the impact of the Mindset Kit on pupils' mindset, it was also important to explore how using the intervention impacted teachers' mindsets. The data are from the experimental condition, as only one teacher completed the post-test measures from the comparison condition. Therefore, the following tests compare pre and post test data for the experimental group only.

As the sample size is very small data were analysed using a series of paired sample t-tests. These were performed using JASP (JASP Team, 2018). As previous evidence suggests that an individual's mindset is highly sensitive and can be manipulated by reading a short passage designed to promote a growth mindset (e.g. Yeager et al., 2016) the tests were one-tailed as there is no evidence to suggest that there would be an effect in the opposite direction. The specified hypothesis of the tests is Time 0 < Time 1, as the direction of the instruments has been configured as a higher score denotes a growth mindset and a lower score denotes a fixed mindset and it is anticipated that reading the Mindset Kit will promote a growth mindset. The JASP default priors were used (Cauchy distribution; location = 0, scale = 0.707) as there is insufficient research evidence available to make a prediction of effect beyond the direction.

Table 40.
Descriptive statistics for psychological variables from teachers.

Time	Condition	N	Mean	SD	Low 95% CI	High 95% CI
Perceptions of the school goal structure for students (mastery)						
0	Comp	4	4.14	0.12	4.03	4.26
0	Exp	8	3.98	0.54	3.61	4.36
1	Exp	5	4.60	0.28	4.36	4.84
Perceptions of the school goal structure for students (performance)						
0	Comp	4	2.70	0.81	1.91	3.49
0	Exp	8	2.78	0.80	2.22	3.33
1	Exp	5	2.80	0.94	1.98	3.62
Personal approaches to instruction (mastery)						
0	Comp	4	4.31	0.32	4.00	4.62
0	Exp	8	3.66	0.38	3.40	3.92
1	Exp	5	4.00	0.53	3.54	4.47
Views about pupils' intelligence						
0	Comp	4	4.67	0.94	3.74	5.59
0	Exp	8	4.25	0.77	3.72	4.79
1	Exp	5	5.33	0.67	4.75	5.92
Personal teaching efficacy						
0	Comp	4	3.64	0.27	3.38	3.91
0	Exp	8	3.70	0.44	3.40	4.00
1	Exp	5	4.14	0.32	3.86	4.42
Views on own intelligence						
0	Comp	4	4.92	0.83	4.100	5.73
0	Exp	8	4.33	1.29	3.443	5.22
1	Exp	5	5.53	0.51	5.090	5.98

A Bayesian T-test compares two hypotheses of effect size, the null hypothesis (H0) being that the effect is absent, whereas the alternative hypothesis (H-) is that the effect size falls on the prior distribution at its peak (Wagenmakers et al., 2018). The test produces a Bayes Factor (amongst other outputs) which is a numerical representation of the intensity of the evidence which data provide for H-. Researchers have applied labels the ranges of potential Bayes which provide a qualitative description of the confidence one may have in the evidence for or against an outcome, this is laid out in Table 41 (Jarosz & Wiley, 2014).

Table 41.
Categorical descriptors of Bayes Factors.

Bayes Factor	Support for H-
1-3	Anecdotal
3-10	Moderate
10-30	Strong
30-100	Very Strong
100+	Decisive

The results of the individual tests are laid out in Figures 23 through 34. There are several key features of the outputs to make clear before discussing the results. Importantly, the Bayes factors are listed as BF_{-0} and BF_{0-}, being the alternative hypothesis and the null hypothesis respectively. In the middle above the graph is a proportion wheel which graphically represents the quantity of evidence of the Bayes factor. The proportion filled in represents the evidence towards the alternative hypothesis and the white section the evidence for the null hypothesis. Designed to represent the likelihood of findings the effect should one throw a dart on the wheel, if it landed on red the effect would be present, and white it would not (Wagenmakers et al., 2018). On the right is displayed the median of the posterior distribution and the 95% credible intervals. Two graphs are presented, the first provides the prior and posterior plots, second is a sequential analysis plot. A sequential analysis shows the change in BF for each individual data point. This is particularly useful in the context of the small N of current data as it provides an insight as to the stability of the effect.

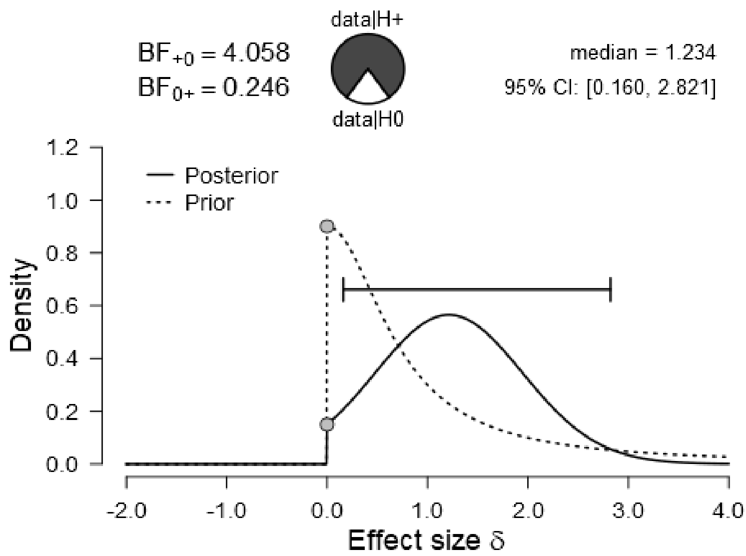

Figure 23. Prior and posterior plot - School mastery goals

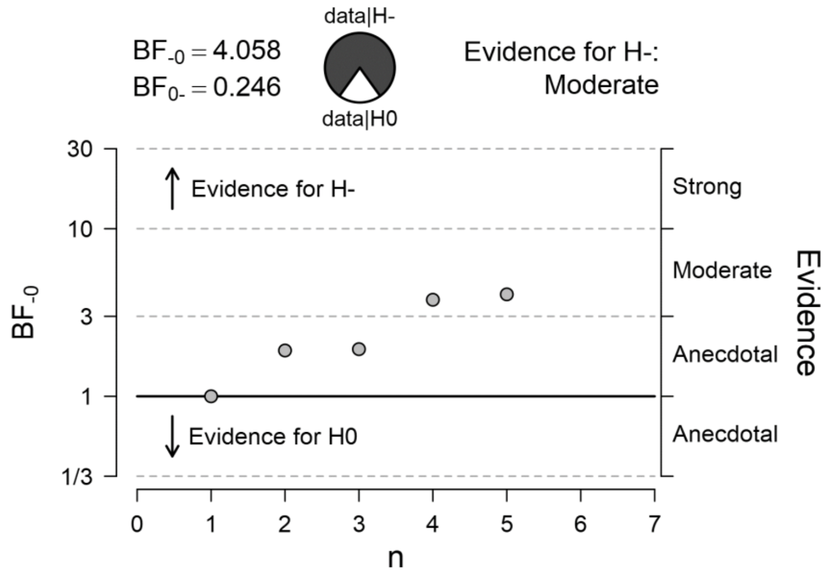

Figure 24. Sequential analysis - School mastery goals

As an approach to the understanding of the evidence the Bayes factor (BF) for alternative hypothesis (H+) will be discussed. In conjunction with this the median of the posterior distribution will also be presented with CIs in brackets. To begin, results for school mastery goals will be explored followed by school performance goals. School mastery goals had a BF of 4.06 and median posterior distribution of 1.23 (0.16, 2.82) which suggests that there was 'moderate' evidence for growth of teachers' observation of whether their school promotes mastery orientated learning (Figure 23). Figure 24 also suggested that more data would result in a more statistically robust relationship. Figure 25 showed that school performance goals have not lowered, with a median posterior distribution of 0.39 (0.02, 1.34), this would be as expected as the intervention did not set out to do this with BFs that did support either H+ or H0. Figure 26 also suggested that additional data would not add any clarity to findings.

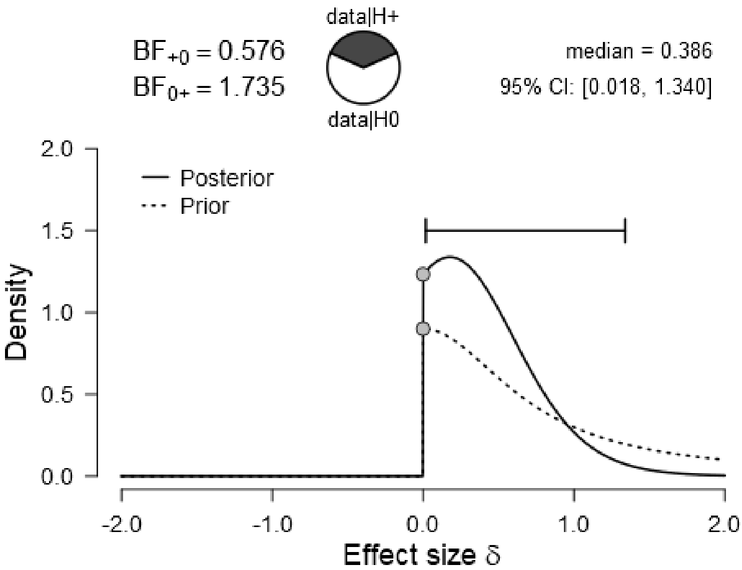

Figure 25. Prior and posterior plot - School performance goals

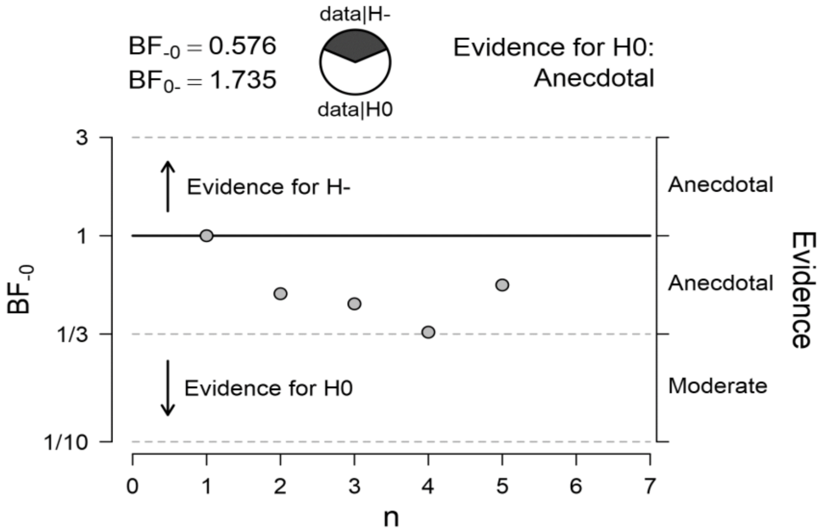

Figure 26. Sequential analysis - School performance goals

Data shown in Figure 27 suggests limited change in teacher's mastery instruction (BF = 1.74 or 'anecdotal' evidence), the median posterior distribution of 0.70 (0.04, 2.00) also mirrors this. Indeed, the sequential analysis (Figure 28) suggests that the majority of evidence provided no information towards either H+ or H0.

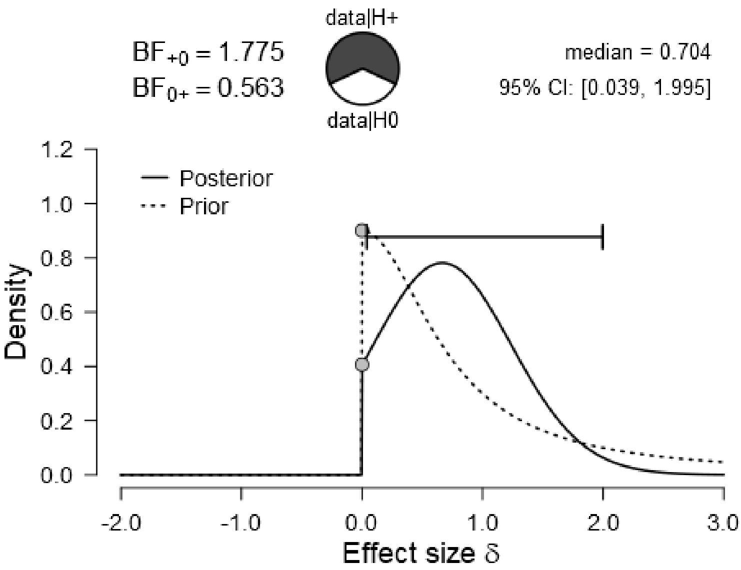

Figure 27. Prior and posterior plot - Mastery instruction

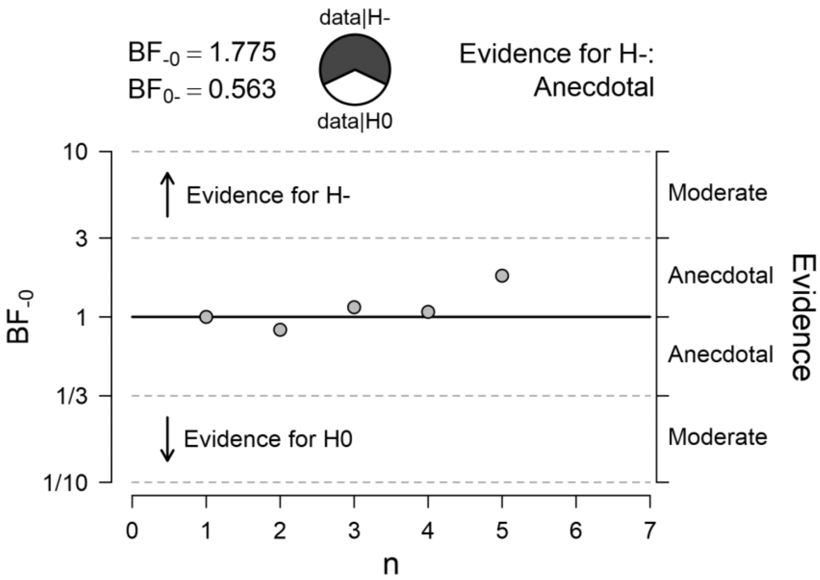

Figure 28. Sequential analysis - Mastery instruction

A Bayes factor of 15.96 can be described as strong evidence for an increase in teachers' beliefs that their pupil's intelligence is something which can be developed (Figure 29), and median posterior distribution of 2.52 (0.95, 4.65). Again, the sequential analysis suggests that a more meaningful relationship may be discovered with more data (Figure 30).

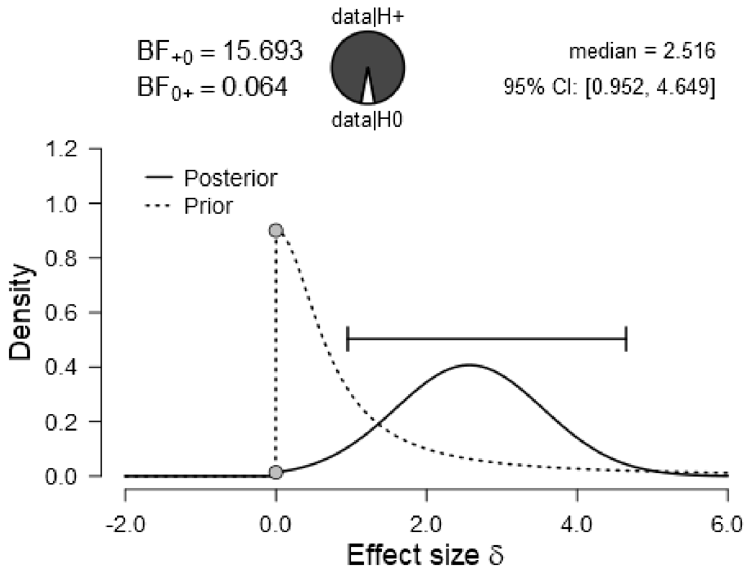

Figure 29. Prior and posterior plot - Pupil mindset

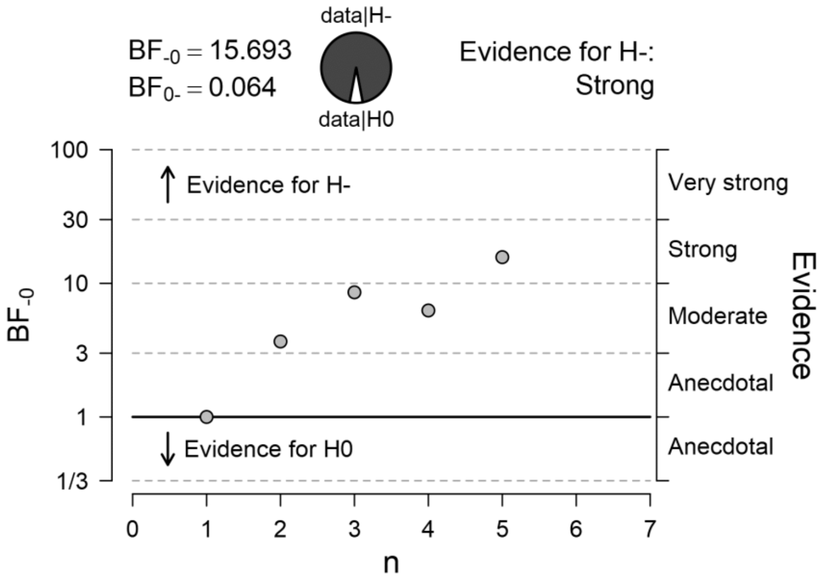

Figure 30. Sequential analysis - Pupil mindset

With a median posterior distribution of 1.86 (0.23, 4.03) and a BF of 9.81, 'moderate evidence' was found for an increase in teachers' beliefs in their teaching efficacy (Figure 31). Data were also shown to be trending towards a more robust relationship by the sequential analysis (Figure 32).

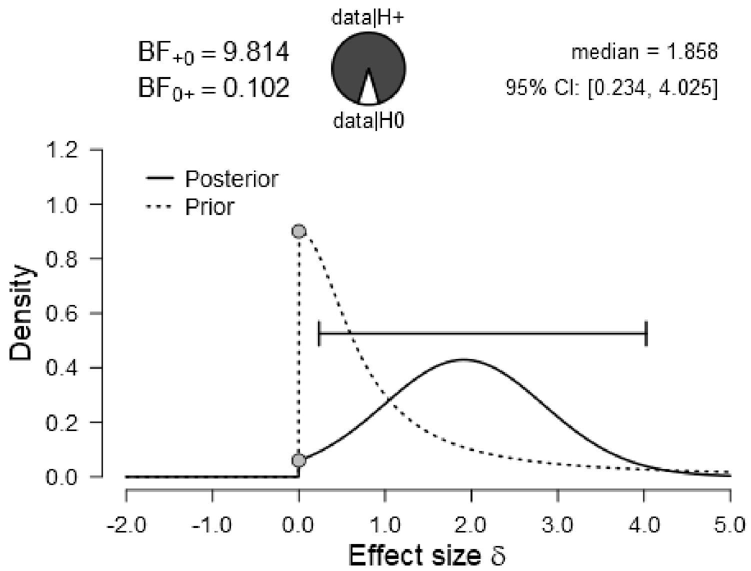

Figure 31. Prior and posterior plot - Teaching efficacy.

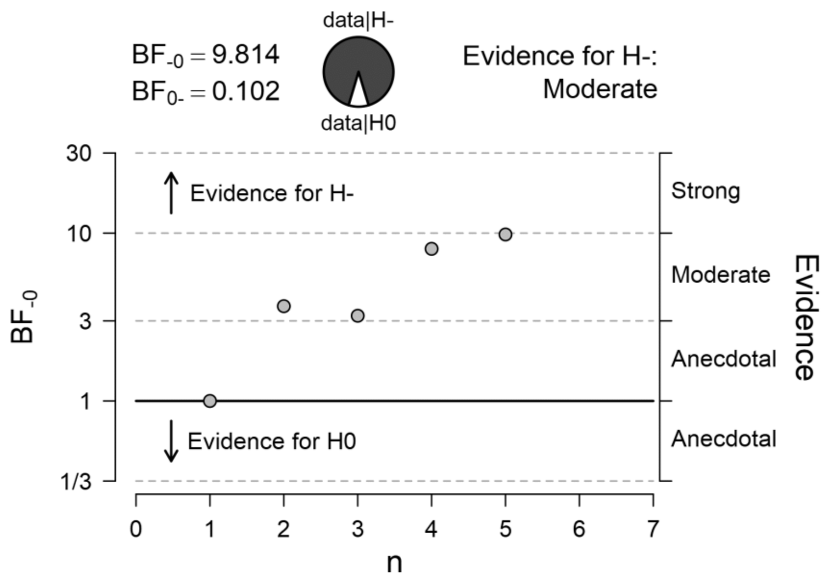

Figure 32. Sequential analysis - Teaching efficacy

Finally, a median posterior distribution of 0.98 (0.10, 2.47) and a Bayes factor of 2.99 (or anecdotal evidence) is found for the intervention influencing teachers views of the malleability of their own intelligence (Figure 11). The sequential analysis (Figure 12) suggested that data were moving towards more of a plateau, meaning that more data may not alter the 'level' of evidence (i.e. BF).

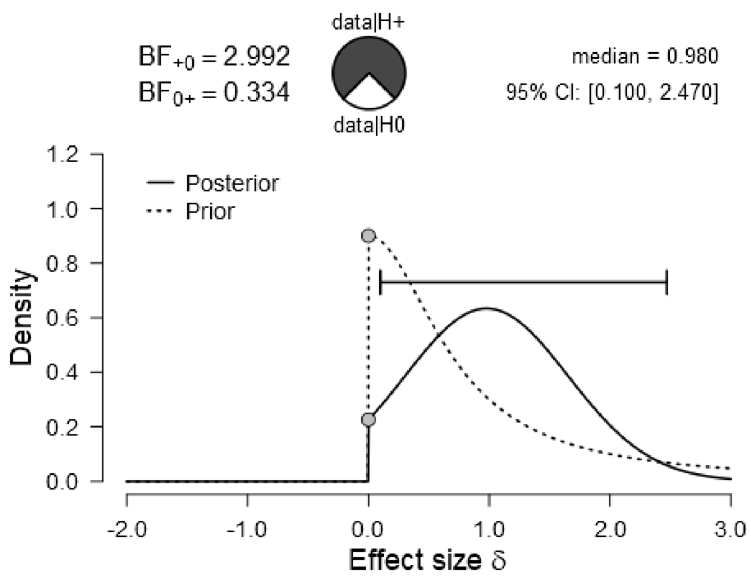

Figure 33. Prior and posterior plot - Self-mindset

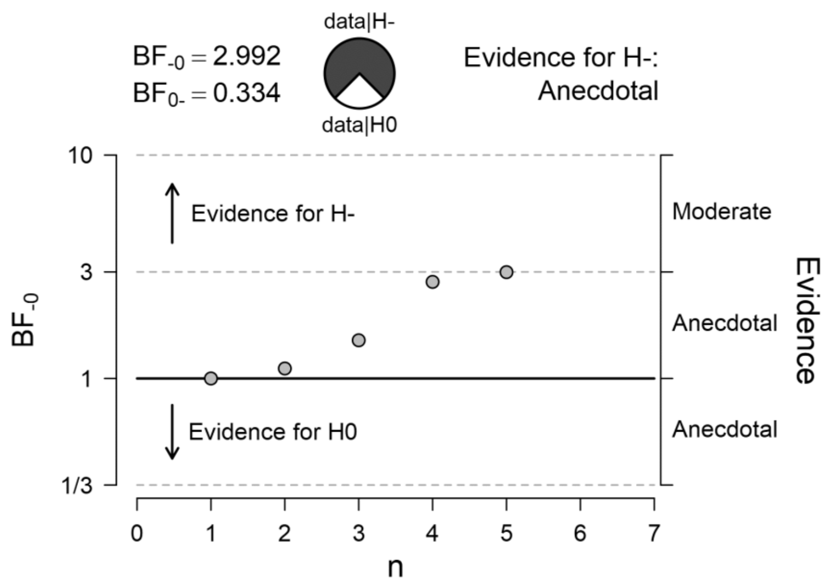

Figure 34. Sequential analysis - Self-mindset

5.8. Discussion

This discussion relates to the research question - "Are teachers' mindsets influenced by using the intervention?". All results in the analyses relating to this research must be considered as requiring more evidence and therefore tentative at best. The sample size is too small to draw firm conclusions which could be reliably replicated. However, it is still useful to explore how using the Stoke Reads Mindset Kit over one year has influenced the educators who used it. The intervention was not designed, nor given to whole schools to use, yet there was evidence that the educators reported an increase in mastery processes within their schools. However, no evidence was found towards any meaningful change in their perception of performance goal-based structures within their schools. At a personal level there was limited evidence to suggest that teachers now felt that their practice was more mastery orientated following their use of the Stoke Reads Mindset Kit. Yet, there was strong evidence that educators felt their practice was more effective. In relation to their pupils, educators' had a more positive outlook in relation to their pupils' potential (or their mindset in relation to their pupils). There was also a reasonable amount of evidence which suggest educators' belief in the potential for their own intelligence to develop has increased.

There was a moderate amount of evidence which suggested that following the intervention, teachers rated their schools as having a more mastery orientated structure. Yet, teachers did not report a reduction in their schools' performance-based structures. Both sets of questions contain elements which ask about celebrating both learning and effort (mastery), or achievement (performance). Schools often focus on celebrating pupils during assemblies where pupils may receive rewards for their achievements (Doyle, 2007). The trial of the Stoke Reads Mindset Kit was not designed to change whole school culture. Therefore, if schools already celebrated student achievement they may have maintained this practice. However, in a recent trial of an intervention to promote growth mindsets by providing development sessions for teachers, it was found that a majority of schools independently shared practice between members of staff (Foliano, Rolfe, Buzzeo, & Runge, 2019). It is plausible that schools may have included more mastery-based elements to their school celebrations or rewards, whilst maintaining performance recognition too.

PALS (Midgley et al., 2005), captures two distinct elements of mastery instruction. First, the recognition of the learning process and effort pupils apply are captured by two questions (e.g. “I make a special effort to recognize students’ individual progress, even if they are performing below where I would expect them to”). Secondly, providing differentiated learning tasks for pupils is captured by Question 14 and 16 (e.g. “During class, I often provide several different activities so that students can choose among them”). However, the Mindset Kit does not directly encourage educators to pursue either of these pedagogical approaches. Therefore, it is unsurprising that there was no marked increase in these behaviours. What it does highlight is that educators may only adopt pedagogical approaches which are explicitly highlighted to them in an intervention. The results from Chapter 2 suggest that the relationships between variables are not necessarily as prescribed by the literature (e.g. by Dweck, 2000). Therefore, despite an increased growth mindset after using the intervention it does not necessarily mean that teachers will spontaneously adopt more growth mindset practice. This conclusion is also supported by previous research suggesting that teacher's practice is not necessarily related to their own personal mindsets (Jonsson, Beach, Korp, & Erlandson, 2012; Park et al., 2016).

There was only an 'anecdotal' amount of evidence to suggest that teachers' personal mindsets became more growth because of the intervention. There was a positive change, but educators reported that they already had what would be considered a growth mindset and the change therefore, was not statistically meaningful. Research suggests that teachers' specialism can influence their mindset, in that teachers with a language or social science background are more likely to endorse a growth mindset compared to mathematics teachers. These findings from Jonsson et al. (2012) were based upon a sample of secondary school teachers and as primary school teachers usually teach all subjects this is less likely to apply. However, they also found that teachers earlier in their career and those towards the end of their career are more likely to endorse a fixed mindset. The current research did not capture this, which may be a factor relevant to understanding how engaging in an intervention such as the Stoke Reads Mindset Kit may change teacher's personal mindsets.

5.9. General conclusion

Previous research has shown that growth mindsets are highly susceptible to change; brief (i.e. 45 minute) web-based activities (Yeager et al., 2019), or subtle changes to feedback (Zhao, Heyman, Chen, & Lee, 2017) are effective at promoting different mindsets and behaviours. The current findings demonstrate that whilst all methods contained with the Mindset Kit may successfully promote a growth mindset, they may also have positive or even negative effects on other elements of the self-theories framework. Only process praise (and only when it is used consistently) generated positive change across all elements of the MMYC, although all elements led to more of a growth mindset. As the evidence in Chapter 2 suggests, the self-theories framework may not hold together as previously suggested and indeed, elements may even be in conflict with each other. The majority of studies which have promoted growth mindsets, particularly in respect to academic achievement (e.g. Yeager et al., 2016) often utilise only implicit theories of intelligence as a measure of mindset and in doing so fail to assess the impact of their interventions on all elements of the theoretical framework (Lüftenegger & Chen, 2017). Even studies which measured the wider framework, such as Blackwell et al. (2007) who measure implicit theories of intelligence, learning and performance goals, beliefs about effort, and responses to failure do not make such assessments and focus solely on how their intervention has influenced implicit theories of intelligence and the effect this has had on academic achievement. Therefore, as all elements of the Mindset Kit have successfully promoted a more incremental theory of intelligence, had the current study focussed only on this construct then the same conclusion would be viable – that the Mindset Kit successfully promotes a growth mindset. However, that conclusion is not valid, and it is not possible to understand whether other studies had similar findings because they only report findings from implicit theories of intelligence instruments. This highlights the importance of researchers utilising the rich theoretical framework of self-theories when considering designing or evaluating interventions to change mindsets.

Findings suggested that engaging with the Stoke Reads Mindset Kit influenced teacher's mindsets, their views of their own practices and school cultures. The intervention was not designed to address the whole school culture, but to change the culture of individual classrooms by modifying the practice of individual educators. Yet, data suggested that at least from the perspective of the teachers in this study, their schools had developed more mastery orientated practices. It is not possible to understand if this was because they may be more sensitive towards mastery orientated practice following their use of the intervention or whether teachers organically share pedagogical practice amongst themselves (Foliano et al., 2019).

Pupil mindset data suggested that teachers developed a substantially different view of their pupils' potential following the intervention. The Mindset Kit was not designed to develop this view in teachers, but to influence their practice as evidence suggests teacher mindsets are not related to their practice (Park et al., 2016). Teachers may have gained a more 'global' growth mindset as a result of engaging with the intervention meaning they viewed others through a more growth mindset lens (Plaks, Levy, & Dweck, 2009). There is a reasonable amount of evidence which suggests that teachers had a more positive view of their teaching efficacy. This supports the findings of Park et al. (2016) that a teacher's mindset is separate from their practice. However, the current research does not explore teachers reasoning behind their new beliefs; what is it that has increased their views surrounding their pupils' potential and their teaching efficacy? It would be advantageous for future research to explore such questions with a more qualitative approach. In understanding why teachers' views have changed, additional content could be added to the Mindset Kit to further supplement and support such changes.

6. Aspiration and Growth Mindsets

This chapter will explore the relationship between future occupational aspiration and mindset. It will begin by setting out the theoretical relationship between aspiration and mindset. Following the outline of the theoretical background there will be a joint presentation of the cross-sectional and causal investigations, consisting of methods section, description of the analytic strategy, and data summary for data from pupils. Next an exploration of relationship between mindset and adults will be presented. The chapter will conclude with a general discussion and conclusion.

6.1 Background

Mindsets are central to how individuals interpret their own and others behaviour (Dweck, 2000). The focus of this thesis is to promote growth mindsets in young children with the aim of increasing academic achievement. Indeed, there is detailed research demonstrating how a growth mindset can benefit the learning process (Blackwell, Trzesniewski, & Dweck, 2007; Claro, Paunesku, & Dweck, 2016; Yeager et al., 2016). In respect of learning, those with a growth mindset understand intelligence to be something which can be developed. With the opposite being true for those with a fixed mindset, they understand intelligence to be genetically determined and something which cannot be changed (Dweck, 2000). Additionally, many different aspects of human social functioning have been suggested to be linked with an individual's mindset. For example, children's social judgements (Levy & Dweck, 1999), teachers' views of gifted pupils (Baudson & Preckel, 2013), allowing stereotypes to inhibit personal performance (Aronson, Fried, & Good, 2002), and even political tolerance and compromise

(Levontin, Halperin, & Dweck, 2013). In changing pupils' mindsets, there may be spill over effects and their overall meaning system may become more incremental.

In the current research, occupational aspiration is defined as the ideal form of employment which the individual wishes to hold in their life. Those with a higher occupational aspiration wish to be employed in more prestigious, or senior roles. This hierarchy of roles is formalised in the Office for National Statistics Standard Occupational Classification framework (Office for National Statistics, 2000). The structure has nine categories, with managers and senior officials in category one, which includes occupations such as 'Directors and chief executives of major organisations'. Through to category nine – elementary occupations, with roles such as a 'car park attendants'. There are many potential barriers to an individual being able to be employed in their ideal job, for example, many higher level, or aspirational, occupations (e.g. surgeon) require substantial education and commitment to a career trajectory to achieve success in those roles (Blustein, 2013). There have been many suggested antecedents of 'low' occupational aspiration offered by the literature. Rice and Rush (1995) interviewed four year olds and found that females aspired to occupations which were higher in educational status and specified a wider variety of occupations. Whereas, males specified traditionally male-sex-typed occupations, such as builder or fireman. This suggests that younger children, especially males, are particularly influenced by stereotypes which limit their aspirations.

Negative stereotypes have been shown to be particularly powerful for pupils from a lower income background, especially those who are White (Strand & Winston, 2008). Strand and Winston (2008) attribute these low aspirations to lower academic self-concept and lower educational aspirations in the home. Many White British 'working class' people do not see education as essential to achieving their vocational goals. A feature which is particularly pertinent for males. Indeed, St Clair and Benjamin (2011) suggest that there are a great many social factors that play into occupational aspiration which is often described with a deficit orientation; society often portrays pupils from a lower socioeconomic background as at fault for not having higher aspirations for themselves. Individuals who are less limited by existing negative stereotypes and have a strong academic-self-concept and sense of self-efficacy are more likely to have higher aspirations. However, having a growth mindset may buffer pupils against the potentially negative influence of stereotypes (Levy, Stroessner, & Dweck, 1998). In turn, this would raise their aspirations as they would understand that they can develop their abilities and feel less limited by their socioeconomic background.

Children who are struggling in education may end up in a recursive spiral of negative achievement creating lowered academic self-concept (Yeager & Walton, 2011). Lowered academic self-concept has been linked with lowered aspirations (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). However, growth mindsets have been shown to be particularly effective at breaking a downward trajectory of academic underachievement (Blackwell et al., 2007). This occurs as an individual with a growth mindset has a more positive response to failure. They have a positive affect following failure, in that they are less concerned about not performing but are more interested in the learning opportunity the task presented and how the failure can show them where to develop (Burhans & Dweck, 1995; Skipper & Douglas, 2012). Thus, restoring a sense of academic achievement and self-concept that would allow the individual to see a higher occupational aspiration as potentially achievable.

Another social cognitive factor in student underperformance is stereotype threat. Stereotype threat occurs when an individual is part of a group with a negative stereotype, an example might be that African American students underachieve in the U.S. higher education. When these stereotypes are made salient individuals can conform to the negative stereotype and in the case of the example, underachieve in higher education (Steele & Aronson, 1995). Previous research has suggested that having a growth mindset can help reduce or remove this burden. Aronson et al. (2002) had undergraduate students wrote letters to advocate the malleability of intelligence to school pupils (i.e. a growth mindset), this generated a growth mindset in the students themselves. As a result of a growth mindset African American students felt their peers did not look down upon them to the same degree, engaged with their schooling more, and enjoyed greater academic achievement compared to those in the control condition. There is a comparison to be drawn between the socially derived stereotypes of racial disadvantage as in Aronson et al. (2002) and the socially derived stereotypes of social disadvantage and subsequent lower aspirations as found in white pupils from challenging economic backgrounds (as in Strand and Winston, 2008).

Stereotypes can be internalised resulting in a negative self-schema, for example, research has shown that females often struggle to envisage themselves as having mathematical ability, should they subscribe to the stereotype that males achieve in mathematics (Nosek, Banaji, & Greenwald, 2002). Understanding abilities as something which can be developed (Dweck, Chiu, & Hong, 1995), not being strongly influenced by stereotypes (Plaks, Levy, & Dweck, 2009), and being more willing to receive counter-stereotypic information (Levy et al., 1998) are features of a growth mindset. Therefore, it is hypothesised that individuals with a growth mindset are more likely to have higher occupational aspiration as they are less likely to be inhibited by negative self-schema or stereotypes.

Other research has sought to directly explore the relationship between mindset and aspiration. Ahmavaara and Houston (2007) drew a sample of two age groups (11-12 and 14-15 years old) from selective and non-selective schools in southern England. They collected data on future aspirations, perceived academic performance, confidence in one's own intelligence, and theory of intelligence. A positive relationship between theory of intelligence and aspiration was found for pupils from selective schools, but not non-selective schools. In the current research it is probable that pupils are sufficiently young to have not yet felt the effects of high-stakes testing or social stigma of school types which Ahmavaara and Houston (2007) found to be a damper on aspiration. An investigation of the relationship between mindset and aspiration without the potential confound of societally received pressures will be possible because of the young age of pupils in the current research. As they do not yet have the capacity for understanding wider societal concepts, such as the educational requirements of becoming a surgeon, or that individuals from certain demographics of society 'do not' become certain professions (i.e. children from lower socioeconomic backgrounds do not study medicine) (Archer & Yamashita, 2003).

Thus, it is reasonable to hypothesise that there will be an association between growth mindsets and aspiration, in that those with a growth mindset will have higher aspirations. This is because a growth mindset will allow the individual to overcome any potential stereotype threat (Aronson et al., 1999; Shapiro, Aronson, & McGlone, 2015). It is hypothesised that pupils' aspirations may be raised because of the intervention as they may no longer be as tied to self, or societally, imposed stereotypes that they are 'unable' to achieve because of their background.

The hypotheses which will be tested in this chapter are:

H_1 – Individuals with a growth mindset will have higher occupational aspirations in childhood and adulthood

H_2 – As a result of the intervention, pupils will have higher occupational aspirations

6.2 Aspiration and Mindsets in Children

Both the cross sectional and causal analyses utilise the same data and therefore a shared presentation of methods, analytical approach, data preparation, and descriptive statistics are reported in Chapter 4.

To investigate pupil's aspiration, Question 7 of the MMYC asks 'What do you want to be when you grow up?'. Their answers are then converted into a single digit code, derived from the major groups of the Office for National Statistics Standard Occupation Classification (SOC2000). The framework provides major groups from 1 to 9, with 1 being the 'highest' level of occupational status, suggesting the 'highest' level of occupational aspiration. These groups are:

1. Managers and senior officials
2. Professional occupations
3. Associate Professional and Technical Occupations
4. Administrative and Secretarial Occupations
5. Skilled Trades Occupations
6. Personal Service Occupations
7. Sales and Customer Service Occupations
8. Process, Plant, and Machine Operatives
9. Elementary Occupations

This approach is taken from the Millennium Cohort Study; however, a shorter version of the full coding scheme was used (Flouri, Moulton, & Panourgia, 2012). This meant data were not coded for gendered roles or intrinsic or extrinsic motivation for the role, only the major Standard Occupation Classification group. These were reverse coded so that a higher score denotes higher aspiration. This was done to make all directionality the same across measures, i.e. higher scores mean more of a 'desired' element of a trait.

6.2.1. General Results

Descriptive statistics are presented in Table 42 and histogram of response frequency for each variable is presented in Figure 1. These data relate to both the cross-sectional and causal analyses of data. The subsequent sections address the cross-sectional and causal structure of the data separately below.

Table 42
Quantity of responses to Question 7, categorised by SOC by Time

Category	Time 0	Time 1
1 – Managers and senior officials	9	10
2 – Professional occupations	100	111
3 – Associate professional and technical occupations	116	128
4 – Administrative and secretarial occupations	0	0
5 – Skilled trades operatives	26	32
6 – Personal service occupations	16	21
7 – Sales and customer services operations	4	5
8 – Process, plant and machine operatives	7	6
9 – Elementary occupations	15	17
10 – Parent	10	8
11 – Fantastical	99	24
12 – Do not know	10	17

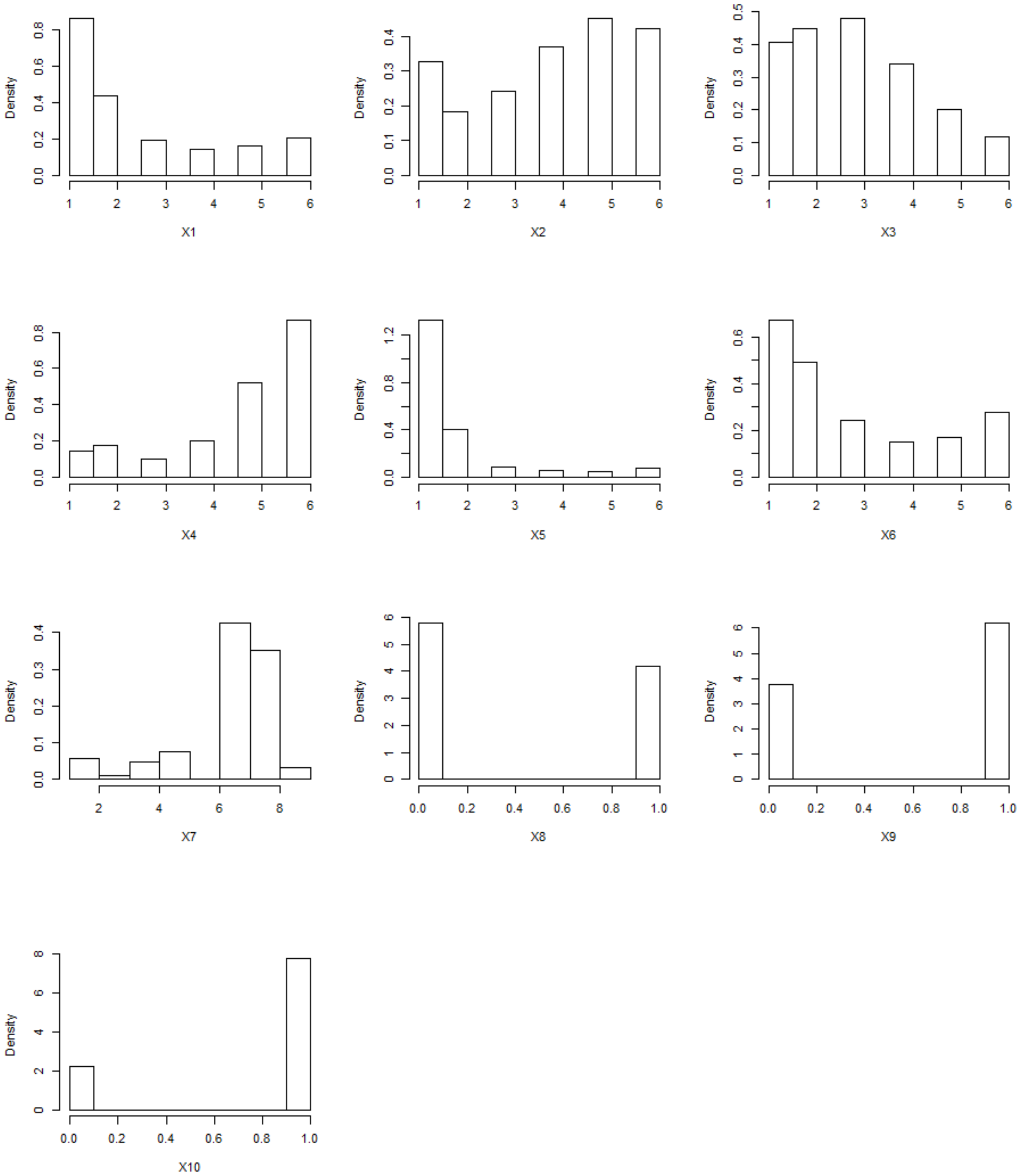

Figure 35. Histogram of Pupil Data

6.2.2. Cross-sectional results

6.2.2.1. Examination of within group variance

The first stage in multi-level modelling is to compare the difference between two 'null' or 'unconditional' models. The first null model (Null Model 1) does not include any grouping factors (i.e. school) and the second does (Null Model 2), meaning that the second model has random intercepts (by school) and the first does not. These null models do not contain predictors and are computed to allow exploration of the extent to which the intercept variance between groups varies, also known as the intraclass correlation (Bliese, 2013).

Null Model 1

Aspiration predicted by constant – without grouping by school

Null Model 2

Aspiration predicted by constant – grouped by school

The results of the comparison can be seen in Table 43, as lower LOOIC scores indicate better model fits, this suggests that Null Model 1 can explain more of the variance in data (Bürkner, 2017; Vehtari, Gelman, & Gabry, 2017).

Table 43
Leave-one-out information criterion for null/unconditional models.

Model	LOO-IC	SE
Null model 1	2285.79	53.09
Null model 2	2288.01	53.29
Difference	-2.22	.89

This suggests that a model which includes a level with grouping by school does not fit the data better than a linear model that does not recognise the groupings. This means that the variation between schools in terms of aspiration is not sufficiently statistically meaningful to merit accounting for in analyses.

6.2.2.2. Multiple regression

Within the brms package, multiple regression is achieved by not inserting the grouping variable. Model 1 presented below investigates the influence of the following on aspiration: all the items from the MMYC, being male (gender), whether the pupil has special educational needs, and speaks English as an additional language.

Model 1 –

> Aspiration predicted by Question 1, 2, 3, 4, 5, 6, 8, 9, 10 and Gender and SEN and EAL

Table 44
Results of Model 1

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI
Question 1	.10	.05	.01	.20
Question 2	-.01	.04	-.11	.07
Question 3	.07	.05	-.03	.18
Question 4	.03	.05	-.13	.07
Question 5	.08	.06	-.04	.20
Question 6	-.08	.04	-.17	.01
Question 8	-.12	.16	-.43	.19
Question 9	-.04	.17	-.37	.30
Question 10	.10	.20	-.29	.47
Gender(1)	-.56	.17	-.89	-.23
SEN(1)	-.17	.34	-.83	.49
EAL(1)	-.08	.32	-.71	.56

N.B. – Gender, SEN, and EAL are all preceded by (1) this is to indicate that the regression is accounting of belonging to that group on the outcome.

The results of Model 1 as shown in Table 44 suggest that Question 1 (performance goal) has a statistically robust relationship with aspiration (.10 [.01, .20]) along with gender (-.56 [-.89, -.23]). However, Question 3 (affect response following failure), Question 5 (affect response following success), and Question 6 (persistence following success) have upper or lower 95% CI ranges which cross zero and are less than their estimate error. When this is the case it is possible to assume that there is a potential relationship, however it is unwise to assume that this relationship is statistically robust (Kruschke, 2015; McElreath, 2016). There is also no effect of Special Educational Needs or speaking English as an additional language on aspiration.

Finally, it is important to test whether Model 1 is a better fit to the data than the null model. The results of the leave-one-out cross-validation show that Model 1 is a better fit to data than Null Model 1, results are below in Table 45.

Table 45

Leave-one-out information criterion for Null Model 1 and Model 1

Model	LOOIC	SE
Null model 1	2285.79	53.09
Model 1	1665.89	47.40
Difference	619.90	36.69

6.2.3. Discussion

In the cross-sectional analyses the only item which had a statistically robust influence over pupil's aspiration was Question 1 - "Let's say that the things to do in this picture are really easy, you will probably get them all right, but you probably won't learn anything new. How do you feel about doing these?" The scoring for this question is not reversed, meaning that pupils who were the happiest about their drawing scored lowest; a lower score on the MMYC suggests a more fixed mindset. The 'things' depicted in Question 1 are deliberately simple (see Appendix G) so that by the end of Reception (Time 0) pupils would be able to easily recognise their abilities would not be challenged by the questions. In being less satisfied by easy questions because they will not learn they are rejecting a performance goal and endorsing a learning goal (Elliott & Dweck, 1988).

Learning goals are central to positive learning behaviours associated with growth mindsets (e.g. Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 2000). However, as the findings presented in previous chapters suggest, data collected for this thesis does not necessarily show a clear link between learning goals and growth mindsets. As there are no relationships between Question 8, 9, or 10 (which ask direct as opposed to proxy theory of intelligence questions) and aspiration, it is possible to conclude from this evidence that a learning goal influences occupational aspiration whereas a growth mindset does not.

Within the MMYC both Question 1 and 2 are designed to capture learning goals yet only Question 1 had a meaningful relationship with aspiration. Question 1 is worded, and scoring is in the direction that pupils would have to reject the statement (i.e. be un-happy about not learning things) to have a more growth mindset score. However, the picture is clouded somewhat by the lack of association between the direct 'positive' learning goal (Question 2) and Question 7 (aspiration). Question 2 asks "Let's say that the things to do in this picture are really hard, you will probably get some of them wrong, but you will probably learn new things. How would you feel about doing these?". There have been some suggestions that individuals who would endorse fixed mindset concepts would also endorse items which depict growth mindset concepts (Hong, Chiu, Dweck, Lin, & Wan, 1999). It is suggested that this occurs because growth mindset items are more compelling and socially desirable. Thus, pupils with both growth and fixed mindsets may have responded positively to Question 2 (learning goal), but only those with a strong growth mindset or learning goal would have rejected

Question 1 (performance goal). Therefore, it is perhaps unsurprising that there is no association between Question 2 and aspiration.

There were also several other items from the MMYC that, whilst they did not have a statistically robust relationship with aspiration the results suggested that there was a relationship between variables. Firstly, Question 3 which measures affect following failure had a positive relationship with aspiration. A positive response to failure (i.e. not catastrophizing and persisting following an error) is a key component to having a growth mindset (Haimovitz & Dweck, 2017). Question 5 also had a positive relationship with aspiration. This item measures the individual's affect following success, i.e. how happy they are with the drawing they got right. However, this item should probably be considered as being worded in a compelling fashion, as it presents young children with the option of being happy about getting things right (Chiu, Hong, & Dweck, 1997). As pupils were asked these questions in a school context it is quite likely that all but those with the very strongest growth mindsets would have rejected this proposition. In having a growth mindset, and therefore a learning goal, theory suggests that they would not be satisfied with the scenario as there is limited opportunity for learning (Ames & Archer, 1988). Question 3 is more likely to give an accurate representation of the distribution of mindsets within the classroom of the affect following failure/success questions. But even that must be considered with an element of caution and not a direct representation of all growth mindsets in the sample, as previous chapters have shown, growth mindsets do not necessarily have the structure previously put forward in the literature. Therefore, it is possible to tentatively conclude that individuals who have a more positive response to failure have higher levels of occupational aspiration.

The emerging picture is one that behaviours associated with a growth mindset have a relationship with occupational aspiration, whereas implicit theories of intelligence do not. However, this is not fully supported by the findings as Question 6 had a negative relationship with aspiration, which was very close to being statistically meaningful. Question 6 asks respondents if they would like to continue practising an already developed skill. Therefore, pupils who responded with a higher score had a growth mindset but had lower aspirations. This pattern of results is not in-line with the traditional description of learning goals as those with a learning goal should be less happy about developing their already proficient skills as they would seek an opportunity to develop (Dinger & Dickhäuser, 2013; Dweck, 2007; Elliott & Dweck, 1988). However, Question 6 may also suffer from the compelling nature which Question 5 also suffers from; asking young pupils to continue doing something they are 'good' at is too tempting.

There was limited evidence found to support Hypothesis 1. This hypothesis was predicated on the assumption that those pupils with a growth mindset would not be inhibited by their own self-limiting stereotypes and therefore have higher aspirations. Being, that pupils whose cognition motivated them to seek more advanced skills did so because of an understanding of their individual potential to develop (Dinger & Dickhäuser, 2013; Grant & Dweck, 2003; Kinlaw & Kurtz-Costes, 2007). However, as no relationships between Question 8, 9, and 10 (which measure theory of intelligence) and Question 7 were found, it is unlikely that implicit theories of intelligence influence aspiration to any meaningful degree. But behaviours traditionally associated with a growth mindset, such as holding a learning goal, do seem to influence occupational aspiration.

6.2.4. Causal relationship results

This section examines how pupils occupational aspiration changed as a result of receiving the intervention. Thus, allowing an exploration of the potential causal relationship between mindset and occupational aspiration.

6.2.4.1. Examination of within group variance

This step has already been completed in the cross-sectional analyses and will not be repeated for the longitudinal data.

6.2.4.2. Multiple regression

To investigate whether pupils who received the intervention had greater occupational aspirations at the end of the year a three-way interaction will be used. An initial model was tested which included every MMYC item in its own three-way interaction. However, this produced an overfitted model. Subsequently models were produced with each item from MMYC separately, as in Model 2. Whilst the models were computed separately the combined outputs will be referred to as Model 2.

Model 2 -

Aspiration ~ Time X condition X (MMYC item)

Table 46
Results of Model 2

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI
Question 1				
Time*Cond*Question	.07	.19	-.29	.44
Time	.84	.40	.10	1.64
Condition	.29	.38	-.42	1.04
Question 2				
Time*Cond*Question	-.13	.19	-.49	.24
Time	.55	.62	-.61	1.78
Condition	.18	.56	-.93	1.30
Question 3				
Time*Cond*Question	-.10	.22	-.52	.32
Time	.36	.51	-.65	1.35
Condition	-.18	.49	-1.15	.77
Question 4				
Time*Cond*Question	-.14	.20	-.54	.26
Time	.22	.68	-1.06	1.55
Condition	-.09	.69	-1.42	1.28
Question 5				
Time*Cond*Question	.23	.27	-.32	.76
Time	.94	.39	.18	1.72
Condition	.62	.42	-.19	1.44

Table 46 continued.
Results of Model 2

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI
Question 6				
Time*Cond*Question	.05	.19	-.31	.41
Time	.83	.41	.02	1.62
Condition	.37	.40	-.39	1.16
Question 8				
Time*Cond*Question	.07	.63	-1.20	1.29
Time	.58	.28	.03	1.11
Condition	.14	.29	-.42	.72
Question 9				
Time*Cond*Question	.80	.65	-.45	2.05
Time	.87	.34	.21	1.54
Condition	.63	.36	-.09	1.36
Question 10				
Time*Cond*Question	-.89	.75	-2.35	.60
Time	-.26	.45	-1.16	.60
Condition	-.37	.45	-1.27	.53

The three-way interaction was not statistically robust in any of the models as shown in Table 50. The models for Question 2, 3, 4, and 10 did not have any statistically robust predictors in them. However, Time was relevant in the models with Question 1, 5, 6, 8, and 9. Time was shown to be a significant predictor in most of the positive change in the comparison group's scores.

6.2.5. Discussion

There was no relationship found between the majority of MMYC measures, time, condition, and aspiration. This is surprising considering that pupils spent a whole year in a classroom in which educators were proactively promoting a growth mindset using the Mindset Kit. These findings are not only in contrast with previous results but also previous research. Indeed, evidence from the cross-sectional analysis suggests a robust relationship between learning goals and aspiration. Also, evidence presented in previous chapters suggests that the Mindset Kit successfully changed various elements of growth mindset thinking in pupils and teachers. Additionally, Yeager et al. (2014) proposed that global implicit theories provide a social cognitive model through which the individual interprets the world, as per Plaks et al. (2009) and Molden and Dweck (2006). In a global, or holistic sense these meaning systems help formulate schema, for example, pupils who have a fixed mindset and struggle at mathematics may conclude that they 'don't have a maths brain'. In the current research it was hypothesised that there would be 'spill-over' effects for pupils who gained a growth mindset from the intervention (Koole & DeHart, 2011). This does not appear to be the case.

As discussed in the previous section, data in this chapter suggest that implicit theories of intelligence do not have a direct role in childrens development of their occupational aspiration. And if they do, the influence is small, and probably part of a wider system involving other variables and mediators not captured in the present research. This is in-line with Gottfredson's theory of circumscription and compromise (Gottfredson, 1981). The theory suggests that occupational aspiration is driven by our self-concepts, including our own genetics and cognitive development. Gottfredson (1981) proposes that we first define a self-concept and then remove occupations which conflict with this self-concept, this process is termed ‘circumscription’. This potential list of occupations is then further reduced by a stage known as ‘compromise’. The theory suggests that during Stage 1 (between 3 and 5 years) young children develop a more concrete (and less fantastic) self-concept and they begin to aspire to actual societal roles or employment. It is in this stage where Gottfredson (1981) suggests that children are making comparisons between size and power between themselves and their peers as this is their current reality, i.e. who is the biggest in the playground. During Stage 2, they often select occupations which are ‘appropriate’ for their gender. Following this, jobs which have insufficient prestige or high difficulty are rejected during Stage 3. Finally, in Stage 4 these preferences are shaped by the individual’s interests and abilities. This process is best represented in Table 47 below.

Table 47.
Gottfredson model of career aspiration development.

Characteristic	Stage 1 – Orientation to size and power	Stage 2 – Orientation towards sex roles	Stage 3 – Orientation to social valuation	Stage 4 – Orientation to internal, unique self
Age	3-5	6-8	9-13	14+
Thought process	Intuitive	Concrete	Less concrete	Abstract
Ability to classify objects, people, occupations	Has not achieved object constancy	Simple groupings	Two-factor groupings	Complex groupings
New elements in perceptions of self and others	Little vs big	Gender	Social class and intelligence	Personal interests, values, and competencies
New elements in occupational perceptions and preferences	Occupations as adult roles	Sextype	Prestige level	Field of work

The pupils within the current data fall between Stage 1 and 2 across the two time points. At Time 0 pupils were between 4.6 and 6.5 years old, with the majority of them in Stage 1. Whereas at Time 1 pupils were between 5.6 and 7.4 years old placing most of them in Stage 2. Between Time 0 and Time 1, as can be seen in the Data Summary section, fewer children reported fantastical career ambitions. Thus, providing support for Gottfredson's (1981) theory as during Stage 1 young children are suggested to move towards more concrete thinking as they enter school (i.e. have less fantastical aspirations). The summary and analysis of data in the current research did not include a break-down of occupational aspirations by gender. However, the negative effect of gender in the cross-sectional analysis shows that males had lower occupational aspirations than females.

6.3. Aspiration and Mindsets in Adults

The following is a presentation of the results of the analysis of the adult data. These data were those from Study 3 of Chapter 3 (Instrument development). The participants, materials, design, and procedure sections are reported in that chapter.

6.3.1. Results

6.3.1.1. Data summary

Table 48 shows the descriptive statistics for Questions 1 through 7 of the MMYC including the Dweck (2000) theory of intelligence instrument. Table 49 shows the descriptive statistics for Questions 8 through 10 of the MMYC in subsets by time and by conditions. The two groups of questions are separated as the dichotomous response format of Question 8 through 10 makes it necessary to report different statistics. As discussed in previous chapters these items must be treated as individual items and not as a single latent variable representing mindsets. Figure 2 displays histograms of individual variables.

Table 48
Summary statistics

	Mean	SD	Low 95% CI	High 95% CI
Question 1	2.68	1.19	2.46	2.91
Question 2	4.38	0.90	4.21	4.55
Question 3	3.04	1.03	2.84	3.23
Question 4	4.68	1.04	4.48	4.88
Question 5	2.17	1.24	1.93	2.40
Question 6	3.42	1.29	3.18	3.66
Question 7	7.84	0.52	7.74	7.94
Dweck	24.92	4.72	24.02	25.81

Table 49
Summary statistics

	Yes (%)	Yes (N)
Question 8	31.78	34
Question 9	98.13	105
Question 10	87.85	94

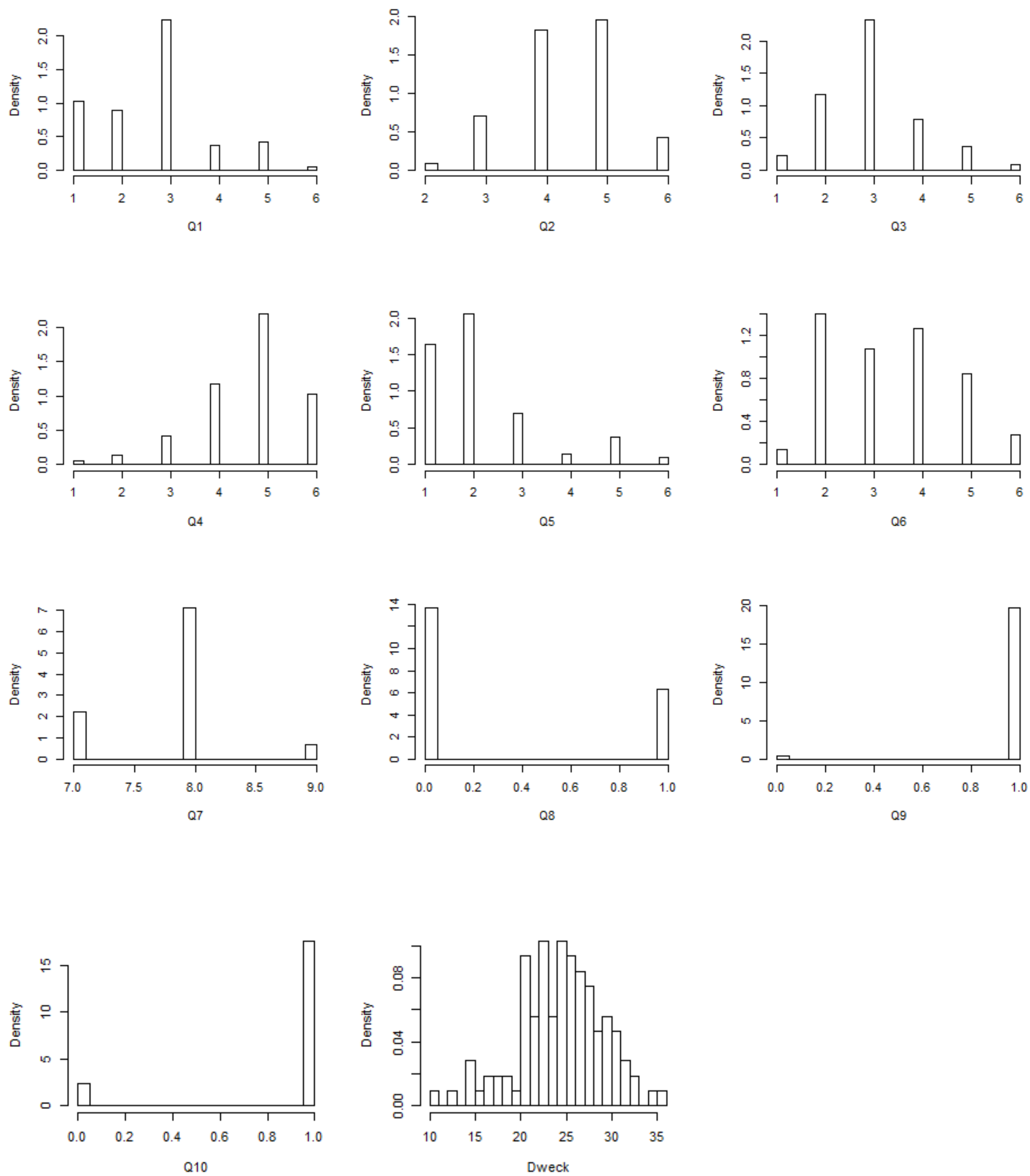

Figure 36. *Histograms of variables*

6.3.1.2. Multiple Regression

To investigate the influence of mindset on adults multiple regression will be used within the BRMS package in R (Bürkner, 2017; R Core Team, 2016).

Model 3 -

Aspiration predicted by Question 1, 2, 3, 4, 5, 6, 8, 9, 10 and Implicit Theory of Intelligence Scale (Dweck) and Gender

Table 50
Results of Model 3

Parameter	Estimate	Estimate Error	Low 95% CI	High 95% CI
Question 1	-.05	.21	-.46	.36
Question 2	.02	.27	-.51	.55
Question 3	-.20	.23	-.66	.25
Question 4	.19	.23	-.25	.64
Question 5	-.07	.19	-.45	.31
Question 6	-.06	.19	-.43	.31
Question 8	.16	.55	-.93	1.24
Question 9	-1.47	1.65	-4.77	1.67
Question 10	.87	.82	-.78	2.47
Dweck	.08	.06	-.03	.20
Gender	-1.33	.53	-2.38	-.32

The results of Model 3 as shown in Table 50 suggest that none of the predictors had a statistically robust relationship with aspiration, apart from gender in which males had lower aspirations. However, the Dweck theory of intelligence instrument has an estimated error that is near equivalent to the estimate (.08[-.03,.20]), which suggests that there was a relationship, but it would be unwise to assume that data fully support this relationship (McElreath, 2016). The results of the leave-one-out cross-validation between the Null model and Model 3 are below in Table 51. These suggested that Model 3 is a poor representation of the data as the LOO-IC value has increased in Model 3. Whilst this was mostly attributable to the greater number of predictors in Model 3, it did not suggest Model 3 is more useful than the Null model for describing the relationships within the data.

Table 51

Leave one out cross validation results for Model 3

Model	LOOIC	SE
Null	165.75	15.77
Model 3	180.48	18.26
Difference	-14.73	7.93

6.3.2. Discussion

Within the sample there were no statistically robust relationships between MMYC variables and aspiration, although there was an influence of gender. This would suggest that adults' aspirations are less influenced by their learning goals than children. However, the characteristics of the adult sample requires closer examination beyond the above tests before any conclusions are drawn. As the sample were undergraduate students enrolled on a Psychology course most responses to Question 7 ("What do you want to be when you grow up?") involved psychology or sub-discipline (e.g. health psychologist, criminal psychologist). As shown in the Figure 2, 70% of responses fell into category 8. The aspiration scale is reversed and category 8 was originally category 2 in the Standard Occupation Classification 2000 (Office for National Statistics, 2000), which is “Professional Occupations” and includes Psychologists (as health professionals) and scientific researchers (academic psychologists). A further 20% were in category 7, originally category 3 being “Associate professional and technical”, the remaining 10% were in category 9, originally category 1 being “Managers and senior officials”. In their responses 77 out of 107 participants aspired to have a career in or involving psychology to some degree. This clustering of responses means that even if learning goals (Question 1 and 2) did have a relationship with aspiration for adults as in the pupil data, it would be challenging to detect as data only represent a small section of the potential relationship as may be found in the wider population. Therefore, the relationship would not be statistically meaningful as the regression slope would be flat and the intercept low (Kruschke, 2015).

Potentially, as university students have much clearer occupational aspirations this may cause them to ignore potential barriers as they are so focussed on their goal. St Clair and Benjamin (2011) investigated the aspirations of 490 pupils aged between 12 and 13 years old in the UK. In their study they found 34.3% and 47.2% reported occupational aspirations in the Standard Occupational Classification (Office for National Statistics, 2000) of category 2 (professional occupations) and category 3 (associate professional and technical occupations) respectively. They suggest that the approach of asking individuals who are aware of their ideal job and their own capacity for achieving is a method which elicits an agentically driven response. Meaning that the individual is expressing their understanding of their current position on a career trajectory and what they can do to achieve it, tempered by what they are capable of achieving. Considering the current findings in this light could potentially explain the lack of relationship between learning goals which were a statistically robust relationship within the data from pupils. This would suggest that in line with Gottfredson's (1981) theory of circumscription and compromise that during Stage 4 individuals will settle upon occupational aspirations in their personal 'zone of acceptable alternatives'. This means that they arrive at an occupational aspiration that sits between their idealistic and realistic aspiration. University students are also much more likely to have a more stable self-identity and awareness and therefore much more stable career ambitions. Thus, their occupational aspirations may not necessarily be as influenced by learning goals as young children's are.

6.4. General discussion

In young children there appears to be a relationship between learning goals and occupational aspiration but not theory of intelligence. In adults there is no relationship between any of the components of a growth mindset, as measured in the MMYC or Dweck's mindset instrument and occupational aspiration. Therefore, it is not possible to suggest that any supporting evidence for either hypothesis was found in the current data. Overall the current data allows for a limited conclusion that aspiration follows a developmental trajectory and offers support to Gottfredson's (1981) theory of circumscription and compromise. It is also important to recognise that there was little evidence of a poverty of aspirations within the sample. This is particularly pertinent within the pupil sample, as these are young children, from a city in which 35% of children live in poverty (End Child Poverty, 2018). Despite the obstacles they may face, which potentially they may be aware of (Weinger, 1998) they still have high occupational aspirations. Which offers support to St Clair and Benjamin's (2011) findings that there is not a paucity of occupational aspiration amongst young people.

The current research, as outlined above, provides some support for the theory of Circumscription and Compromise (Gottfredson, 1981) as aspiration follows a developmental trajectory. Current data allows for inspection of this at a young age, and again with a sample in their late teens. In the younger sample, between Time 0 and Time 1 children made less fantastical aspirations and had more occupational aspirations. The change in pupils' aspirational choices are in-line with the differences between Stage 1 and Stage 2 of Gottfredson's theory (1981). They are also complimentary to previous findings that children begin to more consistently identify with a single occupational aspiration (Hughes, Odom, Woods, & McClellan, 1995). In the adult sample, there were no statistically robust relationships between aspiration and any of the mindset variables. This would support Gottfredson's (1981) notion that following Stage 4, individuals' settle on occupational aspirations which are balanced between their abilities and their willingness to overcome any potential societal barriers to achieving their goal. In a test of Gottfredson's (1981) theory Cochran, Wang, Stevenson, Johnson, and Crews (2011) suggested that parental socioeconomic status and academic ability predict adolescent occupational aspiration. The idea that an individual's mindset has less influence over their occupational aspirations as they develop is partially supported by a model proposed by Bandura, Barbaranelli, Caprara, and

Pastorelli (2001). Whilst this model is a not a developmental one and does not account for external societal factors, their findings suggest that an individual's mindset would only feature as a small determinant of their internal occupational aspiration (see Figure 3). This would be because it would be a sub-component of small elements of the model (i.e. children's social efficacy).

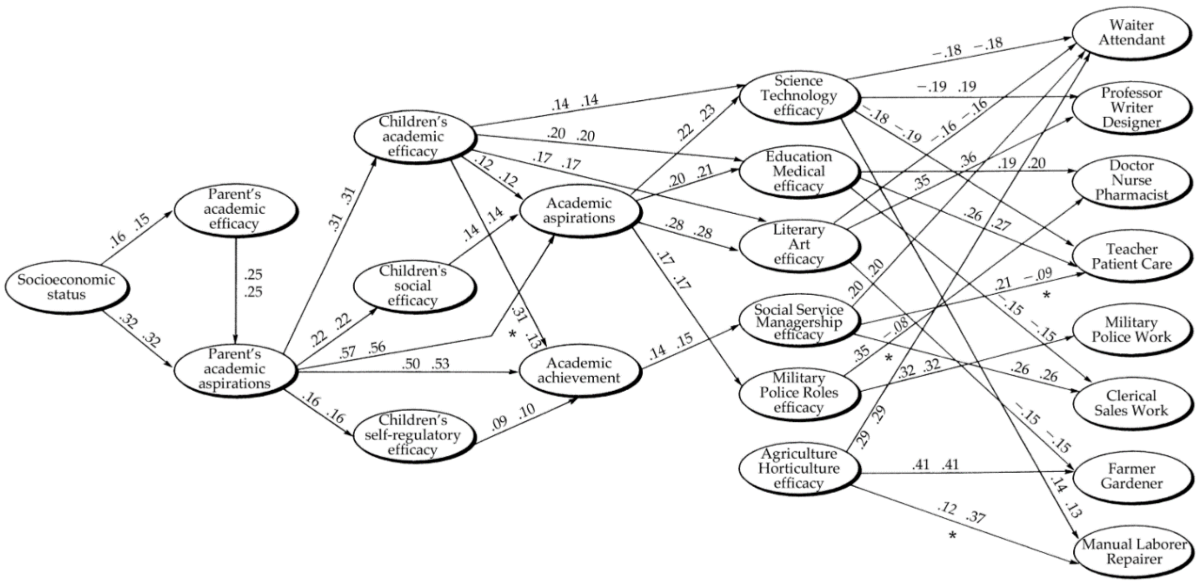

Figure 37. Path model of influences of occupational aspiration. Reprinted from "Self-efficacy beliefs as shapers of children's aspirations and career trajectories." By Bandura, A., Barbarnelli, C., Caprara, G.V., and Pastorelli, C. (2001)

The current findings somewhat contrast with previous research which has investigated mindset and aspiration. Ahmavaara and Houston (2007) modelled the influence of gender, school year, belief in fixed intelligence, school type, school identification, self-esteem, confidence in intelligence, and perceived academic performance on aspirations. However, the reverse should be the case in the non-selective schools. In the current study, all schools were non selective, but we did not find this pattern. This could be because the pupils in the current study were considerably younger than those in Ahmavaara and Houston (2007). Furthermore, the means through which they accessed 'future aspirations' is potentially problematic. The scale comprised of two questions relating to educational aspirations 'I will go to university' and 'I will leave school when I am 16' (reverse scored), and one item relating to occupational aspiration 'What job would you like to do when you have finished your education?'. Their responses were coded into four categories: professional, skilled, semi-skilled, and unskilled. Participants responses to these three questions were then summed to produce a single score. Previous research has suggested that educational and career aspirations (and expectations) are different (Wall, Covell, & Macintyre, 1999). Therefore, it is possible that the positive relationship between mindset and aspiration in selective school pupils as found by Ahmavaara and Houston (2007) may be between mindset and educational aspiration. This relationship may have been strong enough to suggest an overall relationship despite a weak relationship between occupational aspiration and mindset.

There are challenges in capturing occupational aspiration. Several studies have utilised the Office for National Statistic's Standard Organisational Classification system (Office for National Statistics, 2000) to explore aspiration within the UK context (e.g. Elias & Purcell, 2013; Flouri et al., 2012). Such studies provided the motivation for adopting the framework within the current research. However, following data collected in the present study the usefulness of the Standard Organisational Classification (SOC) from the year 2000. Pupils in the current specified occupational aspirations such as "YouTuber", which do not readily fit into a category on the framework. Many countries produce equivalents to the UK

Office for National Statistics SOC (Ganzeboom & Treiman, 1996). The purpose of which is to provide a framework to describe the type of work that people do (Elias & Birch, 2010). Previous work, and subsequently the current research, have failed to recognise this utilitarian function. In doing so researchers may lose the subjective nature of an individual's aspirations. For example, a child of a family that has been economically inactive for many generations, who aspires to be employed in a job categorised as a 'Personal Service Occupation' (e.g. dental nurse or barber) would have a 'low' level of aspiration in the SOC framework. It has been shown that an individual's socioeconomic status and family history influence occupational aspiration (Baker & Brown, 2008; St. Claire, Clift, & Dumbelton, 2008). Yet that individual is aspiring well beyond their own inherited cultural norms and could rightly be suggested to have high aspirations which is not captured with SOC.

The current results do not directly support the hypotheses of this chapter. Yet it would be unwise to not further explore mindsets, along with other cognitive factors in the development of children's occupational aspiration. However, other research has consistently found that external factors, such as parent socioeconomic status, parent aspirations, and wider societal factors such as education systems or perceived social status have powerful influences over occupational aspiration (Archer & Yamashita, 2003; Baker & Brown, 2008; Cochran et al., 2011; St. Claire et al., 2008). Future research would benefit from considering such factors; children do not develop in isolation and are part of much wider systems and it would be beneficial to account for these (Vélez-Agosto, Soto-Crespo, Vizcarrondo-Oppenheimer, Vega-Molina, & García Coll, 2017).

Mindsets may not be linked to career aspirations in the formative way as hypothesised in this chapter but across the life course. Many behaviours associated with a growth mindset would be beneficial in achieving a particular career goal, for example persistence following failure (Haimovitz & Dweck, 2017), resilience (Blackwell et al., 2007), and coping more positively in stressful situations (Schroder et al., 2017), amongst others. Growth mindsets may allow individuals to pursue their aspirational career goals through to fruition. Whereas those with a fixed mindset may not as they fear failure more than those with a growth mindset because often they set themselves lower goals which they are much less likely to fail (Lou & Noels, 2016). Future research should consider the longitudinal influence of growth mindset in changes of occupational aspiration across the life span.

6.5. Conclusion

In summary, the findings of this chapter suggest that whilst there is a possibility that mindsets form a part of a wider network of factors involved in occupational aspiration it is unlikely that the current study successfully captured this. This is probably because the current study was not configured to account for the litany of variables which contribute towards occupational aspiration over the life course. However, the current study did provide support for Gottfredson's theory of circumscription and compromise (1981). Data suggests that children's occupational aspirations develop as they age, and in these formative years their own internal social cognitions play a role in shaping 'what they want to do when they grow up'. Once we become adults, we achieve a balance between our occupational aspiration and societal influences. As this becomes more fixed, our mindset has a smaller part to play in shaping this.

7. General Discussion

The primary objective of this thesis was to create and evaluate an intervention designed to allow educators to promote growth mindset cultures within their classrooms. A co-creative process was adopted for the development of the Stoke Reads Mindset Kit which enlisted teachers, expert reading specialists, speech and language therapists, and academics as equal partners. The context of the research and age range of participants meant it was necessary to develop a growth mindset instrument which was quick to administer and suitable for use with young children. The intervention was evaluated exploring pupils and teachers. This chapter will begin by briefly summarising the previous chapters. In addition, areas of future research will be discussed in conjunction with the limitations of the current research. Overall themes from findings will be situated within the wider literature and practical implications will be discussed. The chapter will conclude with an overall conclusion of the research.

7.1 Context of Current Research

The research presented in this thesis was completed as part of a wider programme from the City of Stoke-on-Trent Council – Stoke Reads. The group consisted of specialist reading advisors, speech and language therapists, academics, and teachers from fourteen local schools. The programme aimed to help early years settings create optimal learning environments for pupils to develop their reading abilities. This was achieved through best practice sharing, conferences, peer support, structured audits of existing practice, events, and a psychological intervention (which this thesis describes). One objective of the programme was to develop 'legacy' outputs, this meant that all products of the programme should not require training to be useful to teachers should the programme no longer be active. This was due to uncertainty in local authority funding in the U.K. during this period (Smith, Phillips, Simpson, Eiser, & Trickey, 2016). To evaluate whether the programme was achieving its aims, schools administered the Phonics and Early Reading Assessment (PERA) to pupils at the beginning and end of Year 1. PERA is an age-standardised test of pupil's phonic decoding abilities, sentence reading abilities, and reading comprehension skills (McCarthy & Ruttle, 2012).

As the City of Stoke-on-Trent has historically had many pupils facing educational barriers (City of Stoke-on-Trent, 2017; Ofsted, 2014) it was decided that a psychological intervention that promoted growth mindsets could help pupils overcome some of these psychosocial barriers (Dweck, 2000). Learners at risk of academic underachievement have been shown to benefit from a growth mindset (Blackwell, Trzesniewski, & Dweck, 2007; Yeager et al., 2019). At the core of a growth mindset is an incremental theory of intelligence, which allows the individual to understand intelligence as malleable; that it can be developed. An individual with a fixed mindset would have an entity theory of intelligence and believe intelligence to be fixed and biologically predetermined. Whereas someone with a growth mindset would have an incremental theory of intelligence and understand that intelligence can be developed and is not predetermined (Dweck, Chiu, & Hong, 1995). It was thought that a growth mindset may be useful to help raise pupils' occupational aspiration, which was a City-wide priority.

Many interventions have been developed that do not involve educators directly in delivery. For example, they may utilise external facilitators to deliver complex content (Blackwell et al., 2007), or have pupils log onto a website to engage with the intervention (Paunesku et al., 2015). This can increase intervention fidelity; however, educators are critically important in promoting growth mindsets and in the broader learning process (Furrer, Skinner, & Pitzer, 2014; Hattie, 2008). Bronfenbrenner proposed the ecological model of human development which highlighted the importance of the wider societal structures on human development (Vélez-Agosto, Soto-Crespo, Vizcarrondo-Oppenheimer, Vega-Molina, & García Coll, 2017). In the current research it was important to change not just the pupils' mindset, but the structures around them in order to facilitate long term change. The Stoke Reads Mindset Kit was developed to enact change in the wider structures pupils were educated in.

7.2. The Mindset Measure for Young Children

Chapter 2 covered the development of a mindset instrument suitable for use with young children. Many different approaches were considered as mechanisms to provide accurate measurement of young children's mindsets, such as the use of 'real' failure scenarios using puzzles or mathematics problems. A great deal of previous research has adopted observations of pupils during such tasks, or researchers have utilised puppets in role-play scenarios involving failure (e.g. Bempechat, London, & Dweck, 1991; Heyman, Dweck, & Cain, 1992). As the current research was part of the Stoke Reads project any measurement of pupil's mindsets needed to take place as part of the PERA testing. This presented several practical challenges; educators administered PERA testing with over 14 schools and nearly 1,000 pupils were involved in the programme. The time it would take to train educators in administering a role play or 'real' failure scenario was substantial, but more importantly it would mean much time spent away from the classroom for both educators and pupils during data collection. Therefore, the most practical and reliable method of measurement was a psychometric instrument – the Mindset Measure for Young Children (MMYC).

The initial version of the MMYC was trialled with adults alongside Dweck's (2000) Implicit Theories of Intelligence Scale with adults. The MMYC items in this version measured achievement goals, essentialism, theory of intelligence, affective responses to failure and success, persistence following failure, and views on academic achievement. This trial was to evaluate whether the MMYC had convergent validity with the extant instrument. The results supported previous findings of acceptable psychometric properties of the Implicit Theories of Intelligence Scale (Dweck, 2000). Additionally, there was good convergent validity between the MMYC items which addressed theories of intelligence, for example questions such as "Do you think you can change how clever you are?" and the Implicit Theories of Intelligence Scale (Dweck, 2000). However, there were limited relationships found between Dweck's instrument and any of the broader MMYC items. Indeed, many of the relationships which were anticipated between items were not found. There is a reasonably strong body of evidence that links theory of intelligence to the various elements that comprise a growth mindset (e.g. learning goals and response to failure) as outlined in Dweck's (2000) monograph. However, there is limited research exploring how the constructs within the framework are related, with only a few exceptions (Blackwell et al., 2007; Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013). It was concluded that either the MMYC had somewhat less than desirable convergent validity, or that the evidence did not support the relationships within the framework. With such a large existing body of evidence supporting links between constructs it was decided that the development of the MMYC continue with further investigations into the framework.

The next study sought to trial the MMYC with young pupils the same age as the intended target group of the Stoke Reads Mindset Kit. Pupils were found to respond well and demonstrate understanding of the questions. This suggested that even young children can meaningfully respond to psychometric instruments which measure complex, nebulous concepts such as theory of intelligence. This study took place over two time points with an assessment of how stable pupil's growth mindsets were over time, with results showing that most items were stable over time. These findings are contrary to some suggestions in the literature that young children do not have a mindset in relation to intelligence and it does not stabilise until they are older (Bempechat et al., 1991). Similarly, as in the previous study, there was no evidence of the internal relationships between constructs of the framework. However, as pupils' mindsets were found to be stable this suggested that the MMYC was an effective psychometric instrument and that it was the framework that needed further investigation.

In a similar fashion to Study 1, the MMYC was assessed for convergent validity in an adult sample. However, in addition to Dweck's (2000) Implicit Theories of Intelligence Scale, additional instruments were included. These covered the other concepts within the MMYC (i.e. learning goals and responses to failure and success) with existing instruments. This was to assess each items' convergent validity. An additional goal of this study was to attempt a conceptual replication of the model of the growth mindset framework presented in Figure 2 of Blackwell et al. (2007). Results suggested that the MMYC items had good convergent validity but there were limited relationships between the different constructs, whether using MMYC items or extant instruments. The conceptual replication of the Blackwell and colleagues (2007) model had failed. It was concluded that it was possible to measure mindsets using the MMYC, however, the framework did not seem to hold together as suggested.

7.3 The Stoke Reads Mindset Kit

This chapter set out the development process which lead to the creation of the Stoke Reads Mindset Kit. Before the process began the literature was reviewed to explore different design approaches to creating educational interventions. With the many factors to consider within the context of the current research, such as the need to produce a 'legacy' product, it was decided that co-creation was the optimal design process to adopt. This process includes a variety of stakeholders as equals in the design process (Bailey et al., 2019; Ramaswamy & Gouillart, 2010). The culmination of the process was the Stoke Reads Mindset Kit, a twenty-four-page intervention designed so that teachers could easily integrate practices which promote growth mindsets into their existing practice without any training.

7.4. The Influence of the Stoke Reads Mindset Kit on Pupils

Chapter 4 evaluated the influence of the Mindset Kit across three different research questions: "Did the intervention change mindsets?", "Are mindsets related to academic performance?", and "Does the intervention improve academic performance?". For clarity the results will be discussed in series as listed.

The research question "Did the intervention change mindsets?" addresses two questions, primarily it asks whether the intervention changed pupil's mindsets. Secondly, it also explored whether there are groups for which the intervention was more or less powerful. Results showed that overall the intervention did change some learning behaviours associated with a growth mindset, such as learning goals, responses to failure and success. It also reduced pupils' views that intelligence is an innate attribute. However, it increased a fixed mindset view of intelligence for themselves and others. Findings also showed that growth mindset messages are not received by all pupils in the same way. For example, males were more likely than females to come to believe that their own intelligence can develop. However, children with EAL were less likely to believe this than their peers. EAL pupils did not impact how children felt about intelligence. Previous research suggests that those at risk of academic underachievement benefit most from a growth mindset (Blackwell et al., 2007; Claro, Paunesku, & Dweck, 2016). The current findings extend this, suggesting that particular groups may be impacted by growth mindsets differently.

The next research question "Are mindsets related to academic performance?" is a more global question and assesses the influence of mindset on pupils' PERA performance, regardless of the intervention. Overall, the majority of MMYC items were found to be predictive of academic performance across phonics, reading, and comprehension elements of the PERA tests. However, there was a negative relationship between pupils' belief that intelligence could be changed and achievement across all three test elements. This is contrary to many of the findings in the literature that growth mindsets, as measured by an implicit theories of intelligence instrument, are educationally beneficial (Paunesku et al., 2015; Yeager et al., 2019). The current findings do not support previous findings; academic benefit was found in the learning behaviours and cognitions as opposed to implicit theories of intelligence directly. In other words, believing intelligence to be malleable did not predict achievement, but learning goals and responses to failure did. Indeed, failing to capture the complete theoretical framework in previous research may mean that researchers have failed to discover potential additional benefits to learners, or indeed the key variables which have impacted them.

The results which addressed the research question "Does the intervention improve academic performance?" suggested that self-mindsets were not related to academic achievement. However, essentialist views of intelligence and other-mindsets were positively predictive of phonics and comprehension results. Learning goals and responses to failure were also positively related to achievement across all three assessments. What is surprising is that that groups at risk of academic underperformance (males, EAL pupils, and SEND pupils) showed no additional benefits from the intervention. This is contrary to previous findings (e.g. Blackwell et al., 2007; Claro et al., 2016) However, overall the evidence does suggest that overall the Stoke Reads Mindset Kit did have modest educational benefits for learners

7.5 The influence of the Stoke Reads Mindset Kit on Teachers

As teachers were the focus of the Stoke Reads Mindset Kit it was important to understand whether their mindsets influenced the effectiveness of the intervention and whether using the Mindset Kit changed their mindset. The first research question addressed in this chapter was “How does teacher’s engagement with the intervention and their own mindset influence the effectiveness of the intervention?”. The analyses broke down teachers’ utilisation of each individual element of the Mindset Kit which allowed for a detailed evaluation of the intervention. Results both supported and added to our understanding of how verbal feedback may be best utilised in classrooms. When educators consistently used process praise it almost universally increased all items on the MMYC. Overall, results showed that the level of teachers’ engagement did matter. This highlighted that some of the more prescriptive elements in the toolkits were more successful in promoting growth mindsets (e.g. progress displays). However, less prescriptive activities, i.e. the ones in which educators needed to be more self-directed in their application (e.g. class discussions) did sometimes promote fixed mindsets.

Data suggested that the Mindset Kit had effects on teachers as well as their pupils. It changed their views of their pupils potential (i.e. mindset for their pupils) and their own self-mindset. Unfortunately, it is not possible to understand from the current analysis whether educator's pupil-mindset developed because of using the intervention or because of the changes they witnessed in their pupils**.** Arguably both outcomes are possible as mindsets are sensitive to change (Dweck, 2000). One of the most striking findings was the increase in teacher's views of their own efficacy. Having used the intervention, teachers became more confident about overcoming educational challenges they faced in their classrooms. Research has shown that teachers who are confident in their own abilities stay in the profession longer, but are also more effective (Pfitzner-Eden, 2016). Using the Mindset Kit over one year substantially increased teachers sense of self-efficacy.

7.6. Growth Mindset and Occupational Aspiration

Within the City of Stoke-on-Trent it was widely appreciated by educators that occupational aspiration was low. A growth mindset has been shown to overcome many social barriers, from stereotype threat for African American University students to reducing long held prejudices (Kahn et al., 2018; Levontin, Halperin, & Dweck, 2013; Yeager, Walton, et al., 2016). It was therefore hypothesised that pupils who were educated in a classroom with a growth mindset culture may have higher occupational aspirations than those in the comparison group. The proposed mechanism was that as implicit theories have been suggested to be 'global', or in other words, individuals can be predisposed to growth theories and they will more likely take a growth perspective on many things. However, data did not support this hypothesis. Indeed, the evidence followed patterns as would be expected according to Gottfredson's (1981) theory of Circumscription and Compromise. It was concluded that occupational aspiration is a multi-faceted and complex process of which a growth mindset is only a small part.

7.7. Evaluation of the research

All research projects inherently contain positive and negative aspects. This section will address these within the current research. The research presented in this thesis was an applied project, it utilised a co-creation process to develop an intervention that educators delivered. Adopting such an approach invites a certain degree of variability, however, it has arguably made the Mindset Kit richer and the lessons learned for educational science more grounded. It is also important to highlight that this can be considered an on-going project and the understanding gained will help inform the next version of the Mindset Kit and provides a range of more fundamental questions to be addressed by researchers in the field.

Primarily one of the main strengths of this thesis was the applied nature of the research. There is a developing trend of mindset interventions of delivering content directly to pupils via the internet (Paunesku et al., 2015; Yeager et al., 2019; Yeager et al., 2016). The motivation for this approach is appreciable; that internet-based interventions scale rapidly and for a very low cost, with high fidelity. If, as previously discussed mindsets are highly sensitive to change, for example, by providing subtly different feedback to pupils (e.g. Skipper & Douglas, 2012) then this presents a fundamental challenge for internet-based interventions. As pupils are exposed to many different environments in which they may be receiving fixed mindset messages that could cancel out the positive effects of the internet-based intervention. By facilitating teachers to develop growth mindset cultures in their classrooms through modifying their practice the Mindset Kit was well placed to ensure pupils regularly received growth mindset messages. Thus, generated a sustained growth mindset in pupils, ensuring any positive effects were robust and lasted over time.

However, a weakness of the research also relates to mindsets over time. As discussed in previous chapters, a limited quantity of work has investigated the durability of growth mindsets propagated by interventions. Effects may fade over time. As highlighted in the previous paragraph – mindsets are sensitive. The configuration of the evaluation of the Mindset Kit only included two time points. It would have been a useful contribution to knowledge to understand whether changes to pupils' mindsets remained stable or whether they faded once they move classes to a teacher who was not part of the intervention. As suggested by Yeager and Walton (2011) interventions should aim to create recursive social processes which strengthen over time. Understanding how pupils' mindsets changed over time following the current research would aid understanding as to whether the Mindset Kit created these recursive processes in the teachers, pupils, or both.

The use of a co-creative design process meant the intervention was able to overcome practical challenges. Primarily these were that teachers within the UK are under substantial pressure, both in respect of their workload and the quantity of content they need to cover in the national curriculum (Hanson, 2018; National Union of Teachers, 2014). Therefore, taking time away from teachers for training on how to use the Mindset Kit or time away from delivering the curriculum in class would not have been appropriate. Additionally, constraints were placed upon the intervention by the Stoke Reads programme (e.g. 'legacy' products). Working with expert practitioners in the development of the Mindset Kit meant that a solution to these challenges was found. The initial intention was to overcome these challenges through developing lesson plans which delivered growth mindset messages in a similar fashion to the sessions developed by Blackwell et al. (2007). These would be tied to the national curriculum so that teachers were not taking time away from curriculum delivery to promote growth mindsets. However, teachers involved in the co-creation process suggested that this was not likely to be adopted by teachers. Additionally, the UK national curriculum had gone through several revisions in as many years and it was therefore likely to change again. This would have potentially meant the content violated our design goal of not taking time away from curriculum delivery as the lesson plans would no longer be on curriculum topics. The co-creation process resulted in an intervention that is well placed to stand the test of time.

A strength of this thesis is that the Mindset Measure for Young Children was developed based upon not just an implicit theory of intelligence but also the learning behaviours associated with a growth mindset. This means that the rich theoretical framework presented by Dweck (2000) was mobilised as opposed to just an implicit theory of intelligence without associated learning behaviours, as is so often the case in mindset research (Lüftenegger & Chen, 2017). This was a strength because this highlighted how the framework may not hold together as prescribed, and whilst this may raise questions it also highlighted promising mechanisms for benefitting pupil attainment. Had this not been the case and only a measure of implicit theory of intelligence been used it was likely that this thesis would have concluded that the Mindset Kit was not an effective intervention. However, it did successfully promote learning behaviours associated with a growth mindset which were academically beneficially to pupils. And whilst results suggested that the MMYC may require further development it is a solid foundation from which to work from.

A potential limitation of the MMYC is the use of the 'hard' and 'easy' scenarios presented to pupils in Question 1 and 2. Research has shown that even very young children, such as those in the current study, are influenced by their own competence-related beliefs, i.e. "Can I do this task?" (Altermatt & Pomerantz, 2003). It may be that some pupil's responses to the questions were not motivated by their respective learning or performance goal, but indeed their perception of their own abilities; those with lower competence-related beliefs would select the 'easy' task with the opposite being true for pupils with higher self-perception. This is likely to be most pertinent for pupils of lower abilities, despite the spellings in the 'easy' task being developed with advice from teachers on what their pupils 'should' be able to access, there will have been pupils who perceived the task as beyond their abilities. To what extent this occurred is unknown in the current research. This presents an avenue for future development that will be outlined below.

Furthermore, with teachers as the target of the intervention the ideal analysis would have included many more schools. The current sample included a representative sample of the socioeconomic spectrum in respect of pupils and school achievement for the City of Stoke-on-Trent. Whilst the sample was sufficient to power the analyses conducted, a broader sample that included more teachers would have produced results more appropriate to make generalised recommendations from. Unfortunately, data were grouped at the school level as opposed to teacher level; meaning some resolution was lost. As highlighted by Yeager et al. (2019) recognising the heterogeneity of schools, their teachers, and their pupils is critically important in research of this type. Whilst the analyses did account for this, the small sample size in respect of number of schools could mean that caution should be taken if results were to be generalised more broadly.

Additionally, classrooms are complex and whilst impractical in context of the current research, a great deal of detail would have been gained through more observational and qualitative methods. For example, whilst there was a reasonable spectrum (i.e. low and high) of uptake of the Mindset Kit by teachers, these were self-reported by educators. Whilst the range of uptake suggests it likely that educators reasonably accurately self-reported, an external assessment of practices would be more accurate. This would take the form of classroom observations which would allow for evaluations of the implementation of the individual elements of the Mindset Kit. For example, such observations would allow questions to be addressed, such as was the verbal feedback that educators delivered specific, contingent, and genuine?

7.8. Wider Implications

There have been some notable failures to replicate the positive benefits of growth mindsets in education (e.g. Bahník & Vranka, 2017; Li & Bates, 2019) and meta-analyses that suggest the educational benefits of a growth mindset are much weaker than previously claimed (Sisk, Burgoyne, Sun, Butler, & Macnamara, 2018). Yet, Yeager et al. (2019) report a pre-registered, randomized control trial, utilising a third-party research company to collect data and a second one to analyse data, which found positive standardised mean difference effect sizes on core course GPA of 0.11. They point out that this equates to nearly 70,000 students prevented from being 'off track' for high school graduation per year. Although the findings of the current research are mixed, they suggest that there is utility in future research exploring growth mindsets and their potential in the classroom. However, it would seem prudent that researchers moderate their expectations of what growth mindset interventions can achieve. This is not a new point in growth mindset research – first raised by Yeager and Walton (2011). Yet seemingly large expectations are consistently made of social psychological interventions in education. This perhaps stems from, particularly in the case of growth mindsets, the somewhat intuitive and optimistic nature of the theory – individuals want to get 'the key' to unlock educational potential in pupils. But the evidence suggest that growth mindsets are only part of the puzzle.

Yeager et al. (2019) report that any positive results of their intervention were significantly affected when students were in a school in which the culture did not support challenge-seeking behaviours. Indeed, they report a greater beta weight for the effect of peer environment than the effect of the intervention on core course GPAs (0.11 and 0.10 respectively). Their conclusion on this finding is that:

> “Sustained change may therefore require both a high-quality seed (an adaptive belief system conveyed by a compelling intervention) and conductive soil in which that seed can grow (a context congruent with the proffered belief system).”

This suggests that future approaches must both promote a school culture of growth mindset and an internalised growth mindset for pupils; a conclusion of the current research. Yet, in a recent interview Dweck has stated her frustration at ‘false’ growth-mindset practices she has witnessed within classrooms (Gross-Loh, 2016). This can include teachers assuming they understand the concept when they do not, or pupils ‘stating’ they have growth mindset when they do not. However, the Stoke Reads Mindset Kit was developed with this in mind, and results do suggest that it is possible to communicate the necessary information to educators, even briefly.

7.9. Future research

The current research was driven by one primary objective – to develop an effective intervention that would promote growth mindsets in classrooms across the Stoke Reads group of schools. The evaluation of the Stoke Reads Mindset Kit suggested that overall this objective had been met. However, it also raised some potentially significant questions about the theory underpinning the intervention.

It seems of critical importance that researchers involved in the ever-growing field of mindset research must address the question of what the framework consists of.

As previously discussed, there have been limited attempts to explore the structure of the theoretical framework, with the notable exceptions being by Blackwell et al. (2007) and Burnette et al. (2013). However, even these are different in their construction and include different variables as part of their models of the framework. Future research must arrive at a consensus of what the structure of the framework looks like. Many of the assumptions of the structure of the framework are based upon individual studies drawn together in the seminal article by Dweck and Leggett (1988), further reinforced by Dweck's (2000) monograph. Indeed, Dweck and Leggett (1988) conclude with "Although much model-testing and model-building research remains to be done, the existing work lends encouraging support to the present model" (pg. 271), one could argue that we are not in a substantially better theoretical position than when they drew that conclusion. Future research must directly address this problem, and researchers should be mindful to integrate the full theoretical framework as opposed to single theory of intelligence instruments.

It has been argued that individuals hold a global mindset, in other words, about themselves generally and whether they are able to change. Levy and Dweck (2009) also state that they have found only moderate correlations between global mindset and domain specific mindsets (e.g. intelligence). Other research has also suggested that mindsets may be subject specific, for example programming (Scott & Ghinea, 2014) and art (Hass, Katz-Buonincontro, & Reiter-Palmon, 2016). So, whilst the individual may have a growth mindset in respect of their intelligence, they may also have a fixed mindset in respect to particular subjects (Leman, Skipper, Watling, & Rutland, 2016). Additionally, current findings suggest that mindset may interact differently with tasks of varying complexity (i.e. phonics, reading, and comprehension). This is also supported by recent findings reported by Li and Bates (2019). If indeed mindsets can be global, and domain specific, and vary by task, then accurately capturing mindsets presents a substantial challenge. Experimental work needs to be conducted to explore these relationships. For example, whilst evidence suggests that providing pupils with a trait-based growth mindset for intelligence has educational advantages (e.g. Yeager et al., 2019); how does that filter down into subject specific mindsets and is it necessary to address these at the subject level?

On the point of measurement, results suggest that there may be areas of the MMYC which require further development. As discussed in the previous chapters, it may be that pupils understand intelligence to be dynamic, but that this change can be both an increase or decrease in their intelligence. This problem would benefit from a qualitative investigation to gain childrens understanding as opposed to just evaluating the psychometric properties of the instrument. In doing so pupils perceptions of the ‘easy’ and ‘hard’ tasks set out in Questions 1 and 2 could be explored. There is a potential currently unquantified risk that some pupils may have responded to the questions based upon perceptions of their own competence. It would be useful to explore if there are any tasks that would minimise this risk. However, it may be that it is impossible to create a task, whether imaginary or real, in which all pupils responses are motivated by their achievement goal and not competence perception.

A more productive avenue to explore may be an approach to capturing the pupil's motivation in their answer by adding in an additional item after Question 2. This approach would be based upon accepting that some pupils will respond from a self-efficacy perspective, in other words whether they are avoiding the 'hard' task because they are concerned about their abilities as opposed to being motivated by their achievement goal. This could be as simple as asking pupils "Were you worried about how hard those problems were?" – although that is only for illustrative purposes and would require development. This question would be a simple check to see if a pupil responded from their self-efficacy perspective and those elements could be discounted from analyses.

A second question which could be added would allow evidence to be collected in-line with the goal complex model (Senko & Tropiano, 2016). The model posits that pupils may have a higher order performance goal (goal reason), whether or not this results in maladaptive is tied to a 'reason'. These reasons are either 'controlling' (e.g. rewards, impressing others) or 'autonomous' (e.g. fun, personal usefulness), it is these reasons which result in maladaptive (e.g. self-handicapping) or adaptive (e.g. self-efficacy). Pupils would be presented with number of possible reasons for their choice and asked to select one. As previously discussed, there are myriad potential 'reasons' which children could have for their decision and therefore the first stage of developing this measure would be to explore common reasons. These reasons would contribute towards the debate surrounding both the goal complex and goal standard models. For example, if the reason was "outperforming others" and this was often selected, it would provide evidence towards the goal standard model as this is the only proposed motivating reason within the goal standard model. Whereas other reasons (e.g. impressing others or personal usefulness) would provide support for the goal complex model as it allows for any 'reason' to be valid. However, any additions must be carefully considered and should not detract from the original purpose of the MMYC – to be an efficient instrument to capture a growth or fixed mindset.

Finally, in relation to measurement, the MMYC did not include effort beliefs, this was because they were considered too conceptually challenging to translate into meaningful psychometric instruments for use with young children within the time scales of the Stoke Reads project. Future work could explore how to measure effort beliefs in young children.

Also owing to time constraints in relation to teacher's time, it was decided to not include content relating to neuroplasticity in the toolkit, although it is a key component in other interventions (e.g. Blackwell et al., 2007). The lack of change in theories of intelligence following the intervention would suggest that it is important to understand if, and how, it may be possible to adapt the 'neuroscience' content of growth mindset interventions designed for older students to younger pupils. If this translation was successful and included into the Mindset Kit, then this might lead to more of a growth mindset in pupils.

Finally, it was not possible in the current research to capture pupils socioeconomic status. Other groups were identified who may be at risk of educational underachievement: males, pupils who have special educational needs or disabilities, and those who speak English as an additional language. However, it was not possible to conclude that a growth mindset provided any substantial educational benefit to their groups. This is contrary to previous research which has suggested that those at risk of educational underachievement benefit the most from a growth mindset (e.g. Blackwell et al, 2007). Future research should endeavour to capture accurate socioeconomic data on participants.

7.10. Conclusions

This thesis presents the results of several studies which were all focussed on the same aim: developing and evaluating an intervention to support educators promoting growth mindsets in their pupils. There is very limited research which has sought to engage teachers as the mechanism for fostering growth mindsets in pupils. The co-creative approach taken in the development stages of the toolkit effectively engaged a range of early years experts. The development of the MMYC suggested that it is possible to utilise psychometric instrumentation to measure mindsets in young pupils. A consistent finding in both pupil and adult samples is that relationships posited to exist in the theoretical framework did not hold as prescribed. However, whilst the framework did not coalesce as expected, many of the items were predictive of educational performance. But notably, the item which measures pupils understanding that they can develop their own intelligence had no relationship (positive or negative) with achievement. Contrary to existing claims, there was no substantial pattern of benefit for pupils at risk of educational underachievement. What results do suggest is that the Mindset Kit was effective at promoting many of the learning behaviours associated with a growth mindset, such as learning goals, but not an implicit theory of intelligence. Yet it did decrease pupils' views that intelligence is innate. Future development work is needed to translate the 'neuroscience' content for use with young pupils. Such content has been found to effectively promote implicit theories of intelligence; such content may 'pump-prime' a growth mindset which is then subsequently developed and sustained by the cultures created by educators. However, as previously discussed there were elements of the Mindset Kit which have been previously shown to promote a growth mindset, such as verbal feedback (Kamins & Dweck, 1988; Gunderson et al., 2018). It may be that as suggested by Cohen and Sherman (2014), social psychological interventions begin a recursive process of adaptive potential. Paunesku et al. (2015) and Yeager et al. (2019) initiated this process by two means. Firstly, participants read an article highlighting how the human brain can grow and reorganise itself by hard work and engaging in challenges. The information focused on the neuroscience underpinning such statements. Students then summarised content in their own words. Secondly, they read a vignette of a struggling student were asked to write advice to them based upon the new knowledge they had just gained. It could be this element of reflection which embeds a growth mindset and begins the recursive process which develops their mindset. However, this is contrary to previous findings which suggest that mindsets are highly sensitive and readily changed, even by subtle changes in language (e.g. Cimpian, Acre, Markman, & Dweck, 2007). Further work must explore whether the neuroscience content and methods of reflection would improve the potential of the Mindset Kit to promote growth mindsets.

In sum, this research presents potentially very fruitful avenues for future research, both for theoreticians and educators. This thesis demonstrates that it is possible to engage teachers in promoting growth mindset in young pupils and that their pupils benefit from being educated in classroom with a growth mindset culture. Additionally, it is also possible to measure young children's mindsets using easily administered instruments. Finally, it suggests that teachers can and indeed, should, be involved in the development and delivery of social-cognitive interventions for use in classrooms.

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Appendices

Appendix A - Ethical approval for initial adult and pupil MMYC trialling

Keele University

Ref: ERP376

12th April 2016

Nick Garnett
School of Psychology
Dorothy Hodgkin Building
Keele University

Dear Nick,

Re: Developing an instrument to measure implicit theories of intelligence in young children

Thank you for submitting your revised application for review. The panel would like to commend you for your full and comprehensive response and amendments.

I am pleased to inform you that your application has been approved by the Ethics Review Panel. The following documents have been reviewed and approved by the panel as follows:

Document(s)	Version Number	Date
Head Teacher Invitation Letter	2	24-03-2016
Head Teacher Consent Form	1	24-03-2016
Parent Invitation Letter	2	24-03-2016
Parent Debrief	2	24-03-2016
Online Debrief	1	01-03-2016
Online Information and Consent Screen	1	01-03-2016
Existing Theory of Intelligence Measures	1	01-03-2016
Instruction Manual for Stoke Reads Toolkit	1	01-03-2016
Response Sheet	1	01-03-2016
Testing Materials	1	01-03-2016

If the fieldwork goes beyond the date stated in your application (1st August 2016), you must notify the Ethical Review Panel via the ERP administrator at research.erps@keele.ac.uk stating ERP1 in the subject line of the e-mail.

If there are any other amendments to your study you must submit an 'application to amend study' form to the ERP administrator stating ERP1 in the subject line of the e-mail. This form is available via http://www.keele.ac.uk/researchsupport/researchethics/.

If you have any queries, please do not hesitate to contact me via the ERP administrator on research.erps@keele.ac.uk stating ERP1 in the subject line of the e-mail.

Yours sincerely

pp C H Bennerman

Mrs Val Ball Chair – Ethical Review Panel

CC RI Manager
Supervisor

Appendix B - Original MMYC formatting

Keele University

City of Stoke-on-T

Q1.2

INFORMATION ABOUT THIS STUDY

You have signed up to take part in this survey which aims to increase understanding about how learners view intelligence. This is a joint project between Stoke Reads (part of Stoke City Council) and Keele University. The survey should take less than 10 minutes to complete and will ask you questions about your views on intelligence. The survey contains several measures which take different approaches to how they ask about how you view intelligence. There are no right or wrong answers; we are simply interested in your opinions. Any information collected in this survey is anonymous; we will not ask for your name. The data will be held securely by Keele University and no attempts will be made to identify any person who completed the survey. You do not have to take part in this research if you choose not to. It is not compulsory; if you do not wish to continue please close your browser window now. Once you have begun the survey and answered any of the questions we will be unable to identify your answers and as such it will be impossible to withdraw them. At the end of the survey you will see a “COMPLETION CODE” – you must type the “COMPLETION CODE” into the microworkers website in order to receive payment for completing this questionnaire. If you close your browser window without noting down the completion code, you need to email Nick Garnett (n.j.garnett@keele.ac.uk) ASAP with the time and date you completed the experiment. If you have any further questions or concerns, please do not hesitate to contact Nick Garnett at: n.j.garnett@keele.ac.uk. Clicking on the "I understand and agree" button below indicates that:

- You have read the above information
- You voluntarily agree to participate
- You understand that there are no right or wrong answers
- You understand that your responses are completely anonymous
- You understand that after pressing agree your responses can not be removed from the study as they are anonymous

○ I understand and agree (1)

○ I do not understand or do not agree (2)

Q2.1 You have a certain amount of intelligence, and you can't really do much to change it

- ◯ Strongly Agree (1)
- ◯ Agree (2)
- ◯ Mostly Agree (3)
- ◯ Mostly Disagree (4)
- ◯ Disagree (5)
- ◯ Strongly Disagree (6)

Q2.2 No matter how much intelligence you have, you can always change it quite a bit

- ◯ Strongly Agree (1)
- ◯ Agree (2)
- ◯ Mostly Agree (3)
- ◯ Mostly Disagree (4)
- ◯ Disagree (5)
- ◯ Strongly Disagree (6)

Q2.3 Your intelligence is something about you that you can't change very much

- Strongly Agree (1)
- Agree (2)
- Mostly Agree (3)
- Mostly Disagree (4)
- Disagree (5)
- Strongly Disagree (6)

Q2.4 You can learn new things, but you can't really change your basic intelligence

- Strongly Agree (1)
- Agree (2)
- Mostly Agree (3)
- Mostly Disagree (4)
- Disagree (5)
- Strongly Disagree (6)

Q2.5 No matter who you are, you can change your intelligence a lot

- Strongly Agree (1)
- Agree (2)
- Mostly Agree (3)
- Mostly Disagree (4)
- Disagree (5)
- Strongly Disagree (6)

Q2.6 You can always greatly change how intelligent you are

- Strongly Agree (1)
- Agree (2)
- Mostly Agree (3)
- Mostly Disagree (4)
- Disagree (5)
- Strongly Disagree (6)

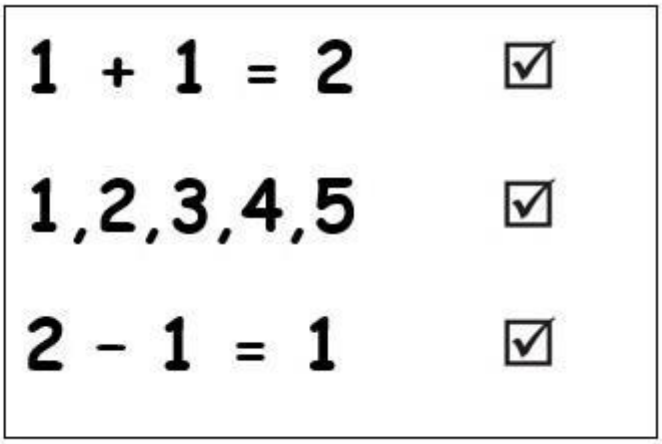
Q3.1 Please complete the following equation. Remember both numbers must add up to 100%.

Intelligence =
Effort : _______ (1)
Ability : _______ (2)
Total : ________

Q4.1 What do you want to be when you grow up?
(please type answer in box)

____

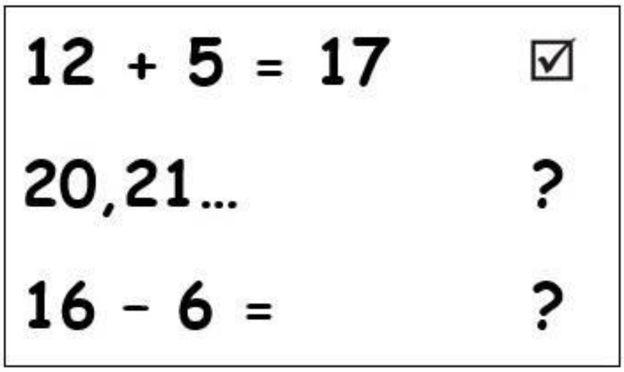
Q5.1



Q5.2 “Let’s pretend that the things to do in this picture are really easy, you will probably get them all right but you probably won’t learn anything new. How would you feel about doing these?”

- ○ Really happy (1)
- ○ Happy (2)
- ○ A little bit happy (3)
- ○ A little bit sad (4)
- ○ Sad (5)
- ○ Really sad (6)

Q6.1



Q6.2 “Let’s pretend that the things to do in this picture are really hard, you will probably get some of them wrong, but you will probably learn new things. How would you feel about doing these?”

○ Really happy (1)

○ Happy (2)

○ A little bit happy (3)

○ A little bit sad (4)

○ Sad (5)

○ Really sad (6)

Q7.1 Are some people born clever?

○ ✔ **YES** (1)

○ **NO** ✗ (2)

Q7.2 Can they change how clever they are?

○ ✔ **YES** (1)

○ **NO** ✗ (2)

Q7.3 Do you think that you can change how clever you are?

○ ✔ **YES** (1)

○ **NO** ✗ (2)

Q7.4 If you learn something new does that make you more clever?

- ○ ✔ **YES** (1)
- ○ **NO** ✗ (2)

Q7.5 Let's say you are doing well in school. Do you think that is because you are trying really hard?

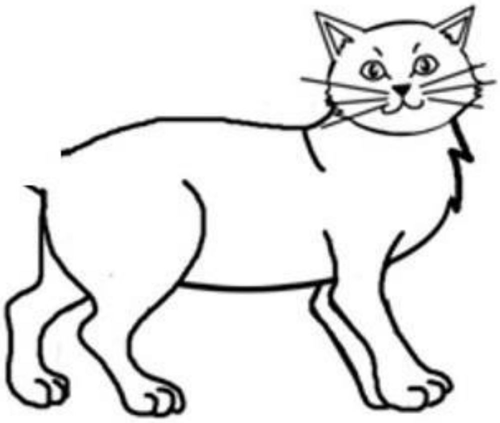
- ○ ✔ **YES** (1)
- ○ **NO** ✗ (2)

Q7.6 Let's say you are doing really well in school. Do you think that is because you are really clever?

- ○ ✔ **YES** (1)
- ○ **NO** ✗ (2)

Q8.1 Let's pretend that you drew these drawings in art class. You made no mistakes when you drew the house, but when you drew the cat you made a mistake and forgot the tail.

Q8.2

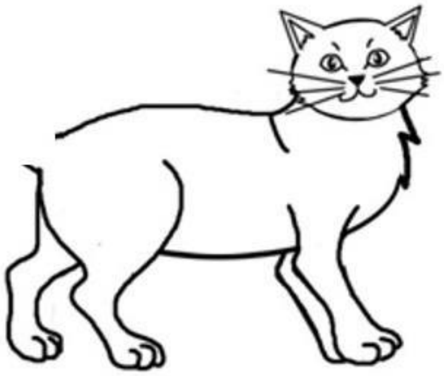


Q8.3 How happy do you feel about your drawing of the cat that you got wrong?

- ○ Really happy (1)
- ○ Happy (2)
- ○ A little happy (3)
- ○ A little sad (4)
- ○ Sad (5)
- ○ Really sad (6)

Q9.1 Let's pretend that you drew these drawings in art class. You made no mistakes when you drew the house, but when you drew the cat you made a mistake and forgot the tail.

Q9.2



Q9.3 If you got the chance to draw one of these again, how happy would you feel about drawing the house that you got right?

○ Really happy (1)

○ Happy (2)

○ A little happy (3)

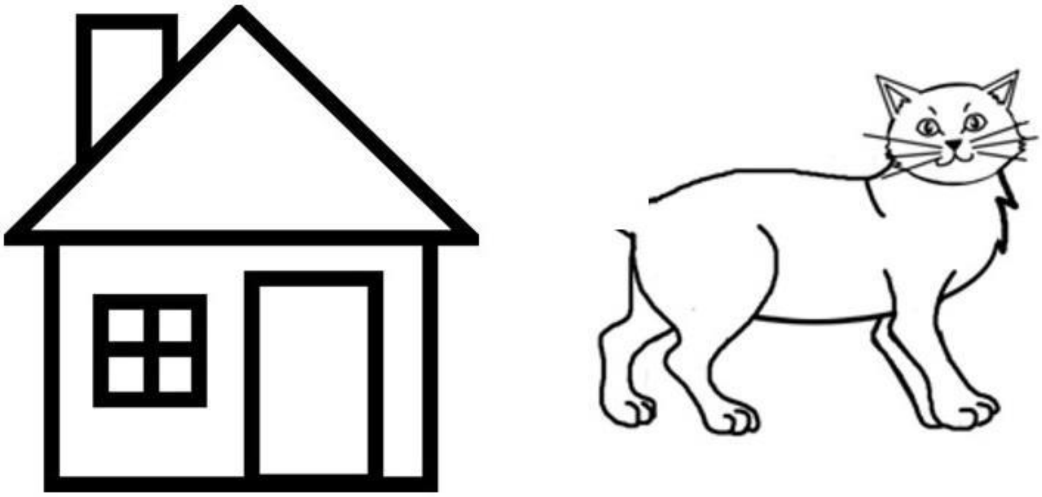
○ A little sad (4)

○ Sad (5)

○ Really sad (6)

Q10.1 Let's pretend that you drew these drawings in art class. You made no mistakes when you drew the house, but when you drew the cat you made a mistake and forgot the tail.

Q10.2

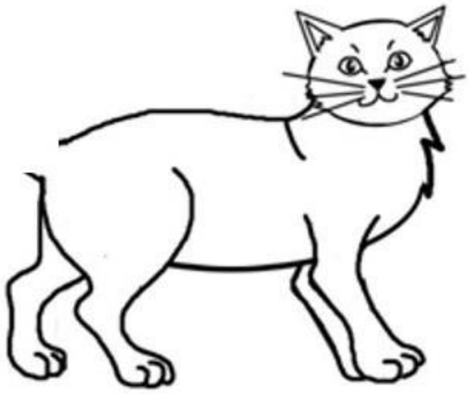


Q10.3 If you got the chance to draw one of these again, how happy would you feel about drawing the cat that you got wrong?

- ○ Really happy (1)
- ○ Happy (2)
- ○ A little happy (3)
- ○ A little sad (4)
- ○ Sad (5)
- ○ Really sad (6)

Q11.1 Let's pretend that you drew these drawings in art class. You made no mistakes when you drew the house, but when you drew the cat you made a mistake and forgot the tail.

Q11.2



Q11.3 How would you feel about practising your drawing the next day?

- ◯ Really happy (1)
- ◯ Happy (2)
- ◯ A little happy (3)
- ◯ A little sad (4)
- ◯ Sad (5)
- ◯ Really sad (6)

Appendix C - Analysis R Code

N.B. This code is also available to download at www.tiny.cc/njgthesis

```
#Introduction to code and author####


#This code was written to analyse data from my DPhil work


#It was written by Nick Garnett (njgarnett@gmail.com)


#Press Alt+O to collapse all folded code

#Press Alt+Shift+O to expand all folded code


#Install and load packages are in separate sections for easy re-load when working

#on data. i.e. select line 22-310 (with collapsed folds) to generate environment for analyses


#Install packages####

install.packages('lubridate')

install.packages('plyr')

install.packages('dplyr')

install.packages('psych')

install.packages('corrplot')

install.packages('lavaan')




#Also requires a C++ compiler, follow instructions on - https://github.com/paul-buerkner/brms


#Optimise RStan config - Run once!

cat('Sys.setenv(BINPREF = "C:/Rtools/mingw_$(WIN)/bin/")',

    file = file.path(Sys.getenv("HOME"), ".Rprofile"),
```

```
    sep = "\n", append = TRUE)


dotR <- file.path(Sys.getenv("HOME"), ".R")
if (!file.exists(dotR))
  dir.create(dotR)
M <- file.path(dotR, "Makevars")
if (!file.exists(M))
  file.create(M)
cat("\nCXXFLAGS=-O3 -Wno-unused-variable -Wno-unused-function",
    file = M, sep = "\n", append = TRUE)

#Now load RStand and BRMS
install.packages("rstan", repos = "https://cloud.r-project.org/",
dependencies=TRUE)
install.packages('brms', dependencies = TRUE)

#NOW RESTART R SESSION BEFORE EXECUTING FOLLOWING SCRIPT

#Load packages and data####
library(lubridate)
library(plyr)
library(dplyr)
library(psych)
library(corrplot)
library(lavaan)
library(rstan)
library(brms)

#display numbers not exponentials and increase maximum row printing for
summary outputs
```

```
options(scipen = 999, max.print = 1000000)

#Tells STAN to use all available cores
options(mc.cores = parallel::detectCores())

# Load pupil data and standaridised score tables
df = read.csv("DATA.csv", na.strings = c("","NA"))
Std_Sent_T1 = read.csv("Std_Sent_Test1_MOD.csv")
Std_Sent_T2 = read.csv("Std_Sent_Test2_MOD.csv")
Std_Phon_T1 = read.csv("Std_Phonics_Test1_MOD.csv")
Std_Phon_T2 = read.csv("Std_Phonics_Test2_MOD.csv")

#Create the age in months at point of testing (Age_at_Test)####
# 1 - Convert df$DOB and df$Test_date from factors into dates
DOB_as_date = dmy(df$DOB)
Test_as_date = dmy(df$Test_date)
df = cbind(DOB_as_date, Test_as_date, df)
df["Test_date"] = NULL
df["DOB"] = NULL
names(df)[2] = "Test_date"
names(df)[1] = "DOB"
rm(DOB_as_date, Test_as_date)

# 2 - create average test date for each school to complete missing test
dates
Avg_date = ddply(df, .(Time, School), summarise, meandate = mean(Test_date,
na.rm=T))

# 3 - creates a list of all cases in df with NA for Test_date
NA_test_date = which(is.na(df$Test_date))
```

```
# 4 - finds all NAs in df$Test_date and replace with date from Avg_date

for (i in NA_test_date){

  TIME = df$Time[i]

  SCH = df$School[i]

  DATE = Avg_date$meandate[which(Avg_date$Time == TIME & Avg_date$School ==
SCH, arr.ind = T)]

  df$Test_date[i] = DATE

}

rm(DATE,TIME,SCH,NA_test_date,Avg_date,i)

summary(df$Test_date) #don't forget to check there are no NAs


# 5- for loops creates age at testing data

NA_DOB_Test = which(!is.na(df$DOB))

for (i in NA_DOB_Test){

  df$Age_at_Test[i] = length(seq(from=df$DOB[i], to=df$Test_date[i],
by='month'))

}

rm(i,NA_DOB_Test)


# 6 - breakdown of missing DoBs

summary(df$DOB)


#Phonics test additions####

#convert df$WordRecog and df$Test to numeric to allow addition

df$WordRecog = as.numeric(as.character(df$WordRecog))

df$Test = as.numeric(as.character(df$Test))


#create phonics total

NA_phon_data = which(df$WordAcc >=0 | df$NonWAcc >=0 | df$WordRecog >=0)

for(i in NA_phon_data){

  df$PhonicsTTL[i] =
rowSums(cbind(df$WordAcc[i],df$NonWAcc[i],df$WordRecog[i]),na.rm = T)
```

```
}

rm(i,NA_phon_data)


#Collect standardised scores from matrix####

#remove first column (scores) as not needed from Std_Phon_T1

Std_Phon_T1[1] = NULL


#create vector of Std_Phon_T1 age in months - no phonics matching because
row = score

Std_Phon_T1_AiM = seq(55, 78)


#creates standardised scores for phonics (Test 1)

Test1_filter = which(df$Test ==1 & df$PhonicsTTL >0 & df$Age_at_Test >=55 &
df$Age_at_Test <= 78)

for(i in Test1_filter){

  AiM = match(df$Age_at_Test[i], Std_Phon_T1_AiM, nomatch=NA)

  df$StdPhonics[i] = Std_Phon_T1[df$PhonicsTTL[i],AiM]

}

rm(AiM, i, Test1_filter, Std_Phon_T1_AiM)


#MATCH & INDEX T2 PHONICS



#create vector of Std_Phon_T1 age in months and score (2-50 so rows do not
equal score)

Std_Phon_T2[1] = NULL # ONLY RUN IF 1ST COLUMN IS NOT STD SCORES!! (I.E.
ONLY FOR NEW LOAD OF MATRICIES)

Std_Phon_T2_AiM = seq(70, 94)

Std_Phon_T2_Score = c(seq(2,50))


#creates standardised scores for phonics (Test 2)

Test2_filter = which(df$Test ==2 & df$PhonicsTTL >0 & df$Age_at_Test >=70 &
df$Age_at_Test <= 94)
```

```
for(i in Test2_filter){

  AiM = match(df$Age_at_Test[i], Std_Phon_T2_AiM, nomatch=NA)

  SCORE = match(df$PhonicsTTL[i], Std_Phon_T2_Score, nomatch=NA)

  df$StdPhonics[i] = Std_Phon_T2[SCORE,AiM]

}

rm(AiM, i, Test2_filter, Std_Phon_T2_AiM, Std_Phon_T2_Score, SCORE)


#####MATCH & INDEX T1 SENTENCE READING


#create vector of Std_Phon_T1 age in months and score

Std_Sent_T1[1] = NULL # ONLY RUN IF 1ST COLUMN IS NOT STD SCORES!! (I.E.
ONLY FOR NEW LOAD OF MATRICIES)

Std_Sent_T1_AiM = seq(55, 78)

Std_Sent_T1_Score = c(seq(5,50),4,3,2,1,0)


#creates standardised scores for Sentence Reading (Test 1)

Test1_filter = which(df$Test ==1 & df$FifthErr >=0 & df$Age_at_Test >=55 &
df$Age_at_Test <= 78)

for(i in Test1_filter){

  AiM = match(df$Age_at_Test[i], Std_Sent_T1_AiM, nomatch=NA)

  SCORE = match(df$FifthErr[i], Std_Sent_T1_Score, nomatch=NA)

  df$StdReading[i] = Std_Sent_T1[SCORE,AiM]

}

rm(AiM, SCORE, i, Test1_filter, Std_Sent_T1_AiM, Std_Sent_T1_Score)


####MATCH & INDEX T2 SENTENCE READING


#create vector of Std_Phon_T1 age in months and score

Std_Sent_T2[1] = NULL # ONLY RUN IF 1ST COLUMN IS NOT STD SCORES!! (I.E.
ONLY FOR NEW LOAD OF MATRICIES)

Std_Sent_T2_AiM = seq(70, 82)

Std_Sent_T2_Score = c(seq(7,50),4,3,2,1,0)
```

```
#creates standardised scores for Sentence Reading (Test 1)

Test2_filter = which(df$Test ==2 & df$FifthErr >=0 & df$Age_at_Test >=70 &
df$Age_at_Test <= 82)

for(i in Test2_filter){

  AiM = match(df$Age_at_Test[i], Std_Sent_T2_AiM, nomatch=NA)

  SCORE = match(df$FifthErr[i], Std_Sent_T2_Score, nomatch=NA)

  df$StdReading[i] = Std_Sent_T2[SCORE,AiM]

}

rm(AiM, SCORE, i, Test2_filter, Std_Sent_T2_AiM, Std_Sent_T2_Score)


rm(Std_Phon_T1, Std_Phon_T2,Std_Sent_T1,Std_Sent_T2)


#Copy EAL/SEN info from first time point in year to second####

EALcopy = which(df$Time ==4)


for (i in EALcopy){

  TIME = df$Time[i]

  TIMEPLUS = TIME+1

  SCH = df$School[i]

  ID = df$ID[i]

  EAL = df$EAL[i]

  df$EAL[which(df$Time==TIMEPLUS & df$School == SCH & df$ID == ID, arr.ind
= T)] = EAL

}

rm(TIME, TIMEPLUS, SCH, ID, EAL,EALcopy,i)


SENcopy = which(df$Time ==4)


for (i in SENcopy){

  TIME = df$Time[i]
```

```
  TIMEPLUS = TIME+1

  SCH = df$School[i]

  ID = df$ID[i]

  SEN = df$SEN[i]

  df$SEN[which(df$Time==TIMEPLUS & df$School == SCH & df$ID == ID, arr.ind
= T)] = SEN

}

rm(TIME, TIMEPLUS, SCH, ID, SEN,SENcopy,i)


#Convert all NAs to 0 in EAL/SEN/Pre.phonics####

df$EAL = as.numeric(df$EAL)

EAL_filter = which(is.na(df$EAL))

for(i in EAL_filter){

  df$EAL[i] = 0

}

rm(EAL_filter, i)


df$SEN = as.numeric(df$SEN)

SEN_filter = which(is.na(df$SEN))

for(i in SEN_filter){

  df$SEN[i] = 0

}

rm(SEN_filter, i)


PrePH_filter = which(is.na(df$Pre.phonics))

for(i in PrePH_filter){

  df$Pre.phonics[i] = 0

}

rm(PrePH_filter, i)


#Create exp/comp identifiers####
```

```
df$exp_comp = NA
exp_filter = which(df$School %in% c("L", "C", "A", "E", "N"))
for(i in exp_filter){
  df$exp_comp[i] = 1
}
rm(exp_filter, i)

comp_filter = which(is.na(df$exp_comp))
for(i in comp_filter){
  df$exp_comp[i] = 0
}
rm(comp_filter, i)
#Re-number case IDs and time points####
df$ID_new = as.numeric(rownames(df))

#concatenate SCH and ID to allow matching
df$Con = paste(df$School,df$ID)

#match only for T5 cases
ID_filter = which(df$Time ==5)
for(i in ID_filter){
  df$ID_new = match(df$Con, df$Con, nomatch=NA)
}
rm(ID_filter, i)

#remove ID and rename ID_new
df$ID = NULL
colnames(df)[colnames(df)=="ID_new"] = "ID"

#recode time points
```

```
df$Time = recode(df$Time, '4'=0L,'5'=1L)


#Remove unused variables and set factors#####

df$WordAcc = NULL

df$NonWAcc = NULL

df$WordRecog = NULL

df$Test_date = NULL

df$DOB = NULL

df$Test = NULL

df$FifthErr = NULL

df$Lang = NULL

df$Test_age = NULL

df$Con = NULL

df$PhonicsTTL = NULL


df$Time = as.factor(df$Time)

df$Gender = as.factor(df$Gender)

df$EAL = as.factor(df$EAL)

df$SEN = as.factor(df$SEN)

df$Pre.phonics = as.factor(df$Pre.phonics)

df$exp_comp = as.factor(df$exp_comp)


#Recode/type pupil variables####

df$X2 = recode(df$X2, '6'=1L,'5'=2L,'4'=3L,'3'=4L,'2'=5L,'1'=6L)

df$X3 = recode(df$X3, '6'=1L,'5'=2L,'4'=3L,'3'=4L,'2'=5L,'1'=6L)

df$X4 = recode(df$X4, '6'=1L,'5'=2L,'4'=3L,'3'=4L,'2'=5L,'1'=6L)

df$X7 = recode(df$X7,
'9'=1L,'8'=2L,'7'=3L,'6'=4L,'4'=6L,'3'=7L,'2'=8L,'1'=9L)

df$X8 = recode(df$X8, '1'=0L,'0'=1L)

df$ReadComp = as.numeric(df$ReadComp)

df$X1 = as.numeric(df$X1)
```

```
df$X2 = as.numeric(df$X2)

df$X3 = as.numeric(df$X3)

df$X4 = as.numeric(df$X4)

df$X5 = as.numeric(df$X5)

df$X6 = as.numeric(df$X6)

df$X8 = as.numeric(df$X8)

df$X9 = as.numeric(df$X9)

df$X10 = as.numeric(df$X10)

df$StdReading = as.numeric(df$StdReading)

df$StdPhonics = as.numeric(df$StdPhonics)

#Load and recode Teacher Variables####

Teacher = read.csv("Teacher.csv")


#School culture - mastery goals - higher score = growth mindset - as per
PALS

Teacher$Q3.4_1_REV = recode(Teacher$Q3.4_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$sch_mastery_goals = rowMeans(Teacher[,c("Q3.2_1", "Q3.3_1",
"Q3.4_1_REV", "Q3.5_1",

                                                "Q3.6_1", "Q3.7_1",
"Q3.8_1")], na.rm = T)


#School culture - Performance goals - all items reverse coded (Q4.5 not -
as reverse coded in PALS manual)

#By reverse coding all items a higher score = growth mindset

Teacher$Q4.2_1_REV = recode(Teacher$Q4.2_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Q4.3_1_REV = recode(Teacher$Q4.3_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Q4.4_1_REV = recode(Teacher$Q4.4_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Q4.6_1_REV = recode(Teacher$Q4.6_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$sch_perfm_goals = rowMeans(Teacher[,c("Q4.2_1_REV", "Q4.3_1_REV",
"Q4.4_1_REV",
```

```
                                                  "Q4.5_1", "Q4.6_1_REV")],
na.rm = T)

Teacher$Q4.5_1_REV = recode(Teacher$Q4.5_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$sch_perfgoals_reg =
rowMeans(Teacher[,c("Q4.2_1","Q4.3_1","Q4.4_1","Q4.5_1_REV","Q4.6_1")],
na.rm=T)


#Approaches to instruction - MASTERY

Teacher$mastery_inst = rowMeans(Teacher[,c("Q5.2_1", "Q5.3_1", "Q5.4_1",
"Q5.5_1")])


#Dweck questions about pupils - all reverse coded so higher score = GM

Teacher$Pupil_dweck = rowMeans(Teacher[,c("Q6.2", "Q6.3", "Q6.4")], na.rm =
T)


#Personal teaching efficacy

Teacher$Q7.3_REV = recode(Teacher$Q7.3_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Q7.5_REV = recode(Teacher$Q7.5_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Q7.7_REV = recode(Teacher$Q7.7_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Teaching_eff = rowMeans(Teacher[,c("Q7.2_1","Q7.3_REV", "Q7.4_1",
"Q7.5_REV", "Q7.6_1", "Q7.7_REV", "Q7.8_1")])


#Dweck and Henderson (SELF FORM)

Teacher$dweck_self = rowMeans(Teacher[,c("Q8.2", "Q8.3", "Q8.4")])


#Activities re-code

Teacher$Verbal_FB = recode(Teacher$Q44_1,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Written_FB = recode(Teacher$Q44_2,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Music = recode(Teacher$Q44_3, '5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Books = recode(Teacher$Q44_4, '5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)
```

```
Teacher$Focused_prac = recode(Teacher$Q44_5,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Dojo = recode(Teacher$Q44_6, '5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Prog_display = recode(Teacher$Q44_7,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)

Teacher$Discussion = recode(Teacher$Q44_8,
'5'=1L,'4'=2L,'3'=3L,'2'=4L,'1'=5L)


Teacher$exp_comp = NA

exp_filter = which(Teacher$School %in% c("L", "C", "A", "E", "N"))

for(i in exp_filter){

  Teacher$exp_comp[i] = 1

}

rm(exp_filter, i)


comp_filter = which(is.na(Teacher$exp_comp))

for(i in comp_filter){

  Teacher$exp_comp[i] = 0

}

rm(comp_filter, i)

#Merge Teacher/Pupil dataframes####

Teacher_merge = Teacher[,c(1,3,35:42,52,57,59,60,61,65:74)]

Teacher_merge = ddply(Teacher_merge, .(School, Time), summarise,

                      sch_mastery_goals = mean(sch_mastery_goals, na.rm =
T),

                      sch_perfm_goals = mean(sch_perfm_goals, na.rm = T),

                      sch_perfgoals_reg = mean(sch_perfgoals_reg, na.rm =
T),

                      mastery_inst = mean(mastery_inst, na.rm = T),

                      pupil_dweck = mean(Pupil_dweck, na.rm = T),

                      teaching_eff = mean(Teaching_eff, na.rm = T),

                      dweck_self = mean(dweck_self, na.rm=T),
```

```
                      verbal_FB = mean(Q44_1, na.rm = T),
                      written_FB = mean(Q44_2, na.rm = T),
                      music = mean(Q44_3, na.rm = T),
                      books = mean(Q44_4, na.rm = T),
                      focus_prac = mean(Q44_5, na.rm = T),
                      dojo = mean(Q44_6, na.rm = T),
                      displays = mean(Q44_7, na.rm = T),
                      discussions = mean(Q44_8, na.rm = T))
Teacher_merge$written_FB = round(Teacher_merge$written_FB, 0)
df = merge(df, Teacher_merge, by = c("School", "Time"), all.x = T)


#Summary stats####
    #Outcome by condition, time, and school####
    Outcomes_time_school = ddply(df, .(exp_comp, Time, School), summarise,
                                 N = length(ID),
                                 Males = length(Gender[Gender==1]),
                                 Females = length(Gender[Gender==0]),
                                 SEN_N = length(SEN[SEN==1]),
                                 SEN_Perc =
length(SEN[SEN==1])/length(SEN)*100,
                                 EAL_N = length(EAL[EAL==1]),
                                 EAL_Perc =
length(EAL[EAL==1])/length(EAL)*100,
                                 Phon_N =
length(StdPhonics[!is.na(StdPhonics)]),
                                 Phon_M = mean(StdPhonics, na.rm = T),
                                 Phon_sd = sd(StdPhonics, na.rm = T),
                                 Phon_SE = Phon_sd / sqrt(Phon_N),
                                 Phon_LowCI = Phon_M +
qnorm(0.025)*Phon_SE,
                                 Phon_HighCI = Phon_M +
qnorm(0.975)*Phon_SE,
```

```
                                Read_N =
length(StdReading[!is.na(StdReading)]),
                                Read_M = mean(StdReading, na.rm = T),
                                Read_sd = sd(StdReading, na.rm = T),
                                Read_SE = Read_sd / sqrt(Read_N),
                                Read_LowCI = Read_M +
qnorm(0.025)*Read_SE,
                                Read_HighCI = Read_M +
qnorm(0.975)*Read_SE,
                                Comp_N =
length(ReadComp[!is.na(ReadComp)]),
                                Comp_M = mean(ReadComp, na.rm = T),
                                Comp_sd = sd(ReadComp, na.rm = T),
                                Comp_SE = Comp_sd / sqrt(Comp_N),
                                Comp_LowCI = Comp_M +
qnorm(0.025)*Comp_SE,
                                Comp_HighCI = Comp_M +
qnorm(0.975)*Comp_SE
    )
    write.csv(Outcomes_time_school, "Outcomes_time_school.csv")


    #Outcomes by Time####
    Outcomes_time = ddply(df, .(Time), summarise,
                          N = length(ID),
                          Males = length(Gender[Gender==1]),
                          Females = length(Gender[Gender==0]),
                          Age_M = mean(Age_at_Test, na.rm=T),
                          Age_med = median(Age_at_Test, na.rm=T),
                          Age_SD = sd(Age_at_Test, na.rm = T),
                          Age_min = min(Age_at_Test),
                          Age_max = max(Age_at_Test),
                          SEN_N = length(SEN[SEN==1]),
                          SEN_Perc = length(SEN[SEN==1])/length(SEN)*100,
```

```
                     EAL_N = length(EAL[EAL==1]),
                     EAL_Perc = length(EAL[EAL==1])/length(EAL)*100,
                     Phon_N = length(StdPhonics[!is.na(StdPhonics)]),
                     Phon_M = mean(StdPhonics, na.rm = T),
                     Phon_sd = sd(StdPhonics, na.rm = T),
                     Phon_SE = Phon_sd / sqrt(Phon_N),
                     Phon_LowCI = Phon_M + qnorm(0.025)*Phon_SE,
                     Phon_HighCI = Phon_M + qnorm(0.975)*Phon_SE,
                     Read_N = length(StdReading[!is.na(StdReading)]),
                     Read_M = mean(StdReading, na.rm = T),
                     Read_sd = sd(StdReading, na.rm = T),
                     Read_SE = Read_sd / sqrt(Read_N),
                     Read_LowCI = Read_M + qnorm(0.025)*Read_SE,
                     Read_HighCI = Read_M + qnorm(0.975)*Read_SE,
                     Comp_N = length(ReadComp[!is.na(ReadComp)]),
                     Comp_M = mean(ReadComp, na.rm = T),
                     Comp_sd = sd(ReadComp, na.rm = T),
                     Comp_SE = Comp_sd / sqrt(Comp_N),
                     Comp_LowCI = Comp_M + qnorm(0.025)*Comp_SE,
                     Comp_HighCI = Comp_M + qnorm(0.975)*Comp_SE
)
write.csv(Outcomes_time, "Outcomes_time.csv")


#Outcomes by Time by SEN####
Outcomes_time_SEN = ddply(df, .(Time, SEN), summarise,
                     N = length(ID),
                     Phon_N = length(StdPhonics[!is.na(StdPhonics)]),
                     Phon_M = mean(StdPhonics, na.rm = T),
                     Phon_sd = sd(StdPhonics, na.rm = T),
                     Phon_SE = Phon_sd / sqrt(Phon_N),
```

```
                        Phon_LowCI = Phon_M + qnorm(0.025)*Phon_SE,
                        Phon_HighCI = Phon_M + qnorm(0.975)*Phon_SE,
                        Read_N = length(StdReading[!is.na(StdReading)]),
                        Read_M = mean(StdReading, na.rm = T),
                        Read_sd = sd(StdReading, na.rm = T),
                        Read_SE = Read_sd / sqrt(Read_N),
                        Read_LowCI = Read_M + qnorm(0.025)*Read_SE,
                        Read_HighCI = Read_M + qnorm(0.975)*Read_SE,
                        Comp_N = length(ReadComp[!is.na(ReadComp)]),
                        Comp_M = mean(ReadComp, na.rm = T),
                        Comp_sd = sd(ReadComp, na.rm = T),
                        Comp_SE = Comp_sd / sqrt(Comp_N),
                        Comp_LowCI = Comp_M + qnorm(0.025)*Comp_SE,
                        Comp_HighCI = Comp_M + qnorm(0.975)*Comp_SE
)
write.csv(Outcomes_time_SEN, "Outcomes_time_SEN.csv")


#Outcomes by Time by Gender####
Outcomes_time_Gender = ddply(df, .(Time, Gender), summarise,
                            N = length(ID),
                            Phon_N =
length(StdPhonics[!is.na(StdPhonics)]),
                            Phon_M = mean(StdPhonics, na.rm = T),
                            Phon_sd = sd(StdPhonics, na.rm = T),
                            Phon_SE = Phon_sd / sqrt(Phon_N),
                            Phon_LowCI = Phon_M + qnorm(0.025)*Phon_SE,
                            Phon_HighCI = Phon_M + qnorm(0.975)*Phon_SE,
                            Read_N =
length(StdReading[!is.na(StdReading)]),
                            Read_M = mean(StdReading, na.rm = T),
                            Read_sd = sd(StdReading, na.rm = T),
```

```
                                Read_SE = Read_sd / sqrt(Read_N),
                                Read_LowCI = Read_M + qnorm(0.025)*Read_SE,
                                Read_HighCI = Read_M + qnorm(0.975)*Read_SE,
                                Comp_N = length(ReadComp[!is.na(ReadComp)]),
                                Comp_M = mean(ReadComp, na.rm = T),
                                Comp_sd = sd(ReadComp, na.rm = T),
                                Comp_SE = Comp_sd / sqrt(Comp_N),
                                Comp_LowCI = Comp_M + qnorm(0.025)*Comp_SE,
                                Comp_HighCI = Comp_M + qnorm(0.975)*Comp_SE
    )
    write.csv(Outcomes_time_Gender, "Outcomes_time_GENDER.csv")


    #Outcomes by Time by EAL####
    Outcomes_time_EAL = ddply(df, .(Time, EAL), summarise,
                                  N = length(ID),
                                  Phon_N =
length(StdPhonics[!is.na(StdPhonics)]),
                                  Phon_M = mean(StdPhonics, na.rm = T),
                                  Phon_sd = sd(StdPhonics, na.rm = T),
                                  Phon_SE = Phon_sd / sqrt(Phon_N),
                                  Phon_LowCI = Phon_M +
qnorm(0.025)*Phon_SE,
                                  Phon_HighCI = Phon_M +
qnorm(0.975)*Phon_SE,
                                  Read_N =
length(StdReading[!is.na(StdReading)]),
                                  Read_M = mean(StdReading, na.rm = T),
                                  Read_sd = sd(StdReading, na.rm = T),
                                  Read_SE = Read_sd / sqrt(Read_N),
                                  Read_LowCI = Read_M +
qnorm(0.025)*Read_SE,
                                  Read_HighCI = Read_M +
qnorm(0.975)*Read_SE,
```

```
                                Comp_N =
length(ReadComp[!is.na(ReadComp)]),
                                Comp_M = mean(ReadComp, na.rm = T),
                                Comp_sd = sd(ReadComp, na.rm = T),
                                Comp_SE = Comp_sd / sqrt(Comp_N),
                                Comp_LowCI = Comp_M +
qnorm(0.025)*Comp_SE,
                                Comp_HighCI = Comp_M +
qnorm(0.975)*Comp_SE
    )
    write.csv(Outcomes_time_EAL, "Outcomes_time_EAL.csv")

    #ToI Variables####
    ToI_Vars = ddply(df, .(exp_comp, Time), summarise,
                    X1_N = length(X1[!is.na(X1)]),
                    X1_M = mean(X1, na.rm = T),
                    X1_sd = sd(X1, na.rm = T),
                    X1_se = X1_sd / sqrt(X1_N),
                    X1_LowCI = X1_M + qnorm(0.025)*X1_se,
                    X1_HighCI = X1_M + qnorm(0.975)*X1_se,

                    X2_N = length(X2[!is.na(X2)]),
                    X2_M = mean(X2, na.rm = T),
                    X2_sd = sd(X2, na.rm = T),
                    X2_se = X2_sd / sqrt(X2_N),
                    X2_LowCI = X2_M + qnorm(0.025)*X2_se,
                    X2_HighCI = X2_M + qnorm(0.975)*X2_se,

                    X3_N = length(X3[!is.na(X3)]),
                    X3_M = mean(X3, na.rm = T),
                    X3_sd = sd(X3, na.rm = T),
                    X3_se = X3_sd / sqrt(X3_N),
```

```
X3_LowCI = X3_M + qnorm(0.025)*X3_se,
X3_HighCI = X3_M + qnorm(0.975)*X3_se,

X4_N = length(X4[!is.na(X4)]),
X4_M = mean(X4, na.rm = T),
X4_sd = sd(X4, na.rm = T),
X4_se = X4_sd / sqrt(X4_N),
X4_LowCI = X4_M + qnorm(0.025)*X4_se,
X4_HighCI = X4_M + qnorm(0.975)*X4_se,

X5_N = length(X5[!is.na(X5)]),
X5_M = mean(X5, na.rm = T),
X5_sd = sd(X5, na.rm = T),
X5_se = X5_sd / sqrt(X5_N),
X5_LowCI = X5_M + qnorm(0.025)*X5_se,
X5_HighCI = X5_M + qnorm(0.975)*X5_se,

X6_N = length(X6[!is.na(X6)]),
X6_M = mean(X6, na.rm = T),
X6_sd = sd(X6, na.rm = T),
X6_se = X6_sd / sqrt(X6_N),
X6_LowCI = X6_M + qnorm(0.025)*X6_se,
X6_HighCI = X6_M + qnorm(0.975)*X6_se,

X7_N = length(X7[!is.na(X7)]),
X7_M = mean(X7, na.rm = T),
X7_sd = sd(X7, na.rm = T),
X7_se = X7_sd / sqrt(X7_N),
X7_LowCI = X7_M + qnorm(0.025)*X7_se,
X7_HighCI = X7_M + qnorm(0.975)*X7_se,
```

```
                    X8_1_Perc = length(X8[X8==1])/length(X8)*100,
                    X8_1_Count = length(X8[X8==1]),
                    X9_1_Perc = length(X9[X9==1])/length(X9)*100,
                    X9_1_Count = length(X9[X9==1]),
                    X10_1_Perc = length(X10[X10==1])/length(X10)*100,
                    X10_1_count = length(X10[X10==1])
    )

    write.csv(ToI_Vars, "TOI_Vars_summary.csv")

    #Teacher summary data####
    Teacher_summary_mindset = ddply(Teacher, .(Time,exp_comp), summarise,
                                    sch_mast_N = length(sch_mastery_goals),
                                    sch_mast_M = mean(sch_mastery_goals,
na.rm = T),
                                    sch_mast_sd = sd(sch_mastery_goals,
na.rm = T),
                                    sch_mast_SE = sch_mast_sd /
sqrt(sch_mast_N),
                                    sch_mast_LowCI = sch_mast_M +
qnorm(0.025)*sch_mast_SE,
                                    sch_mast_HighCI = sch_mast_M +
qnorm(0.975)*sch_mast_SE,

                                    sch_perf_N = length(sch_perfm_goals),
                                    sch_perf_M = mean(sch_perfm_goals,
na.rm = T),
                                    sch_perf_sd = sd(sch_perfm_goals, na.rm
= T),
                                    sch_perf_SE = sch_perf_sd /
sqrt(sch_perf_N),
                                    sch_perf_LowCI = sch_perf_M +
qnorm(0.025)*sch_perf_SE,
```

```
sch_perf_HighCI = sch_perf_M +
qnorm(0.975)*sch_perf_SE,

mast_inst_N = length(mastery_inst),
mast_inst_M = mean(mastery_inst, na.rm
= T),
mast_inst_sd = sd(mastery_inst, na.rm =
T),
mast_inst_SE = mast_inst_sd /
sqrt(mast_inst_N),
mast_inst_LowCI = mast_inst_M +
qnorm(0.025)*mast_inst_SE,
mast_inst_HighCI = mast_inst_M +
qnorm(0.975)*mast_inst_SE,

pupil_dweck_N = length(Pupil_dweck),
pupil_dweck_M = mean(Pupil_dweck, na.rm
= T),
pupil_dweck_sd = sd(Pupil_dweck, na.rm
= T),
pupil_dweck_SE = pupil_dweck_sd /
sqrt(pupil_dweck_N),
pupil_dweck_LowCI = pupil_dweck_M +
qnorm(0.025)*pupil_dweck_SE,
pupil_dweck_HighCI = pupil_dweck_M +
qnorm(0.975)*pupil_dweck_SE,

teaching_eff_N = length(Teaching_eff),
teaching_eff_M = mean(Teaching_eff,
na.rm = T),
teaching_eff_sd = sd(Teaching_eff,
na.rm = T),
teaching_eff_SE = teaching_eff_sd /
sqrt(teaching_eff_N),
teaching_eff_LowCI = teaching_eff_M +
qnorm(0.025)*teaching_eff_SE,
```

```
                                teaching_eff_HighCI = teaching_eff_M +
qnorm(0.975)*teaching_eff_SE,


                                dweck_self_N = length(dweck_self),
                                dweck_self_M = mean(dweck_self, na.rm =
T),
                                dweck_self_sd = sd(dweck_self, na.rm =
T),
                                dweck_self_SE = dweck_self_sd /
sqrt(dweck_self_N),
                                dweck_self_LowCI = dweck_self_M +
qnorm(0.025)*dweck_self_SE,
                                dweck_self_HighCI = dweck_self_M +
qnorm(0.975)*dweck_self_SE


    )
    write.csv(Teacher_summary_mindset, "Teacher_mindset_summary.csv")


    #Teacher summary - toolkit####
    Teacher_summary_toolkit = ddply(Teacher, .(Time), summarise,
                                Verb_feed_N = length(Q44_1),
                                Verb_feed_M = mean(Q44_1, na.rm = T),
                                Verb_feed_sd = sd(Q44_1, na.rm = T),
                                Verb_feed_SE = Verb_feed_sd /
sqrt(Verb_feed_N),
                                Verb_feed_LowCI = Verb_feed_M +
qnorm(0.025)*Verb_feed_SE,
                                Verb_feed_HighCI = Verb_feed_M +
qnorm(0.975)*Verb_feed_SE,


                                writ_feed_N = length(Q44_3),
                                writ_feed_M = mean(Q44_3, na.rm = T),
                                writ_feed_sd = sd(Q44_3, na.rm = T),
                                writ_feed_SE = writ_feed_sd /
sqrt(writ_feed_N),
```

```
writ_feed_LowCI = writ_feed_M +
qnorm(0.025)*writ_feed_SE,
writ_feed_HighCI = writ_feed_M +
qnorm(0.975)*writ_feed_SE,

music_N = length(Q44_4),
music_M = mean(Q44_4, na.rm = T),
music_sd = sd(Q44_4, na.rm = T),
music_SE = music_sd / sqrt(music_N),
music_LowCI = music_M +
qnorm(0.025)*music_SE,
music_HighCI = music_M +
qnorm(0.975)*music_SE,

books_N = length(Q44_5),
books_M = mean(Q44_5, na.rm = T),
books_sd = sd(Q44_5, na.rm = T),
books_SE = books_sd / sqrt(books_N),
books_LowCI = books_M +
qnorm(0.025)*books_SE,
books_HighCI = books_M +
qnorm(0.975)*books_SE,

focus_prac_N = length(Q44_6),
focus_prac_M = mean(Q44_6, na.rm = T),
focus_prac_sd = sd(Q44_6, na.rm = T),
focus_prac_SE = focus_prac_sd /
sqrt(focus_prac_N),
focus_prac_LowCI = focus_prac_M +
qnorm(0.025)*focus_prac_SE,
focus_prac_HighCI = focus_prac_M +
qnorm(0.975)*focus_prac_SE,

dojo_N = length(Q44_7),
```

```
                                    dojo_M = mean(Q44_7, na.rm = T),

                                    dojo_sd = sd(Q44_7, na.rm = T),

                                    dojo_SE = dojo_sd / sqrt(dojo_N),

                                    dojo_LowCI = dojo_M +
qnorm(0.025)*dojo_SE,

                                    dojo_HighCI = dojo_M +
qnorm(0.975)*dojo_SE,


                                    prog_disp_N = length(Q44_8),

                                    prog_disp_M = mean(Q44_8, na.rm = T),

                                    prog_disp_sd = sd(Q44_8, na.rm = T),

                                    prog_disp_SE = prog_disp_sd /
sqrt(prog_disp_N),

                                    prog_disp_LowCI = prog_disp_M +
qnorm(0.025)*prog_disp_SE,

                                    prog_disp_HighCI = prog_disp_M +
qnorm(0.975)*prog_disp_SE,


                                    class_disc_N = length(Q44_9),

                                    class_disc_M = mean(Q44_9, na.rm = T),

                                    class_disc_sd = sd(Q44_9, na.rm = T),

                                    class_disc_SE = class_disc_sd /
sqrt(class_disc_N),

                                    class_disc_LowCI = class_disc_M +
qnorm(0.025)*class_disc_SE,

                                    class_disc_HighCI = class_disc_M +
qnorm(0.975)*class_disc_SE

    )

    write.csv(Teacher_summary_toolkit, "Teacher_summary_toolkit.csv")


#Assumptions####

hist(df[,7], main = "Q1", prob = T)

lines(density(df[,7], na.rm = T))
```

```
exp_df_T0 = subset(df, exp_comp==1 & Time==0)

exp_df_T1 = subset(df, exp_comp==1 & Time==1)

comp_df_T0 = subset(df, exp_comp==0 & Time==0)

comp_df_T1 = subset(df, exp_comp==0 & Time==1)

multi.hist(exp_df_T0[,c(7:19)], main = "exp_df_T0")

multi.hist(exp_df_T1[,c(7:19)], main = "exp_df_T1")

multi.hist(comp_df_T0[,c(7:19)], main = "comp_df_T0")

multi.hist(comp_df_T1[,c(7:19)], main = "comp_df_T1")


multi.hist(exp_df_T0[,14], main = "exp_df_T0")

multi.hist(exp_df_T1[,14], main = "exp_df_T1")

multi.hist(comp_df_T0[,14], main = "comp_df_T0")

multi.hist(comp_df_T1[,14], main = "comp_df_T1")


#Correlation between variables####

#T0&1 pupil variables

pupilvars = df[,c(7:18)]

pupilvars = na.omit(pupilvars)

pupilvars_p = cor.mtest(pupilvars, conf.level = .95)

pupilvars = cor(pupilvars)

corrplot(pupilvars, method = "number", order = "original", cl.pos = "b",

         p.mat = pupilvars_p$p,

         insig = "blank")

#Research Q1 - Was the intervention successfull in promoting growth
mindsets?####

#Select and merge teacher with pupil data

#data frame as X1:6 needs to integer for cumulative distribution

df$X1 = as.integer(df$X1)

df$X2 = as.integer(df$X2)

df$X3 = as.integer(df$X3)

df$X4 = as.integer(df$X4)
```

```
df$X5 = as.integer(df$X5)

df$X6 = as.integer(df$X6)


dfRq1 = df[complete.cases(df[,c(1:5,7:12,14:16,20:22)]),]


  #Step 1 - Examination of with-in group variance####

  #for Q1:6

  Q1_NULL_1 = brm(mvbind(X1, X2, X3 , X4 , X5, X6) ~ 1,

                  data = dfRq1,

                  seed = 1234)

  Q1_NULL_1_LOO = loo(Q1_NULL_1)


  Q1_NULL_1_sch = brm(mvbind(X1, X2, X3 , X4 , X5, X6) ~ 1 + (1|School),

                      data = dfRq1,

                      control = list(adapt_delta = 0.95),

                      seed = 1234)

  Q1_NULL_1SCH_LOO = loo(Q1_NULL_1_sch)


  Q1_NULL_1_COMP = loo_compare(Q1_NULL_1_LOO, Q1_NULL_1SCH_LOO) # use
grouping


  #For Q8:10

  Q1_NULL_2_sch = brm(mvbind(X8, X9, X10) ~ 1 + (1|School),

                      data = dfRq1,

                      family = 'bernoulli',

                      seed = 1234)

  Q1_NULL_2SCH_LOO = loo(Q1_NULL_2_sch)


  Q1_NULL_2 = brm(mvbind(X8, X9, X10) ~ 1,

                  data = dfRq1,

                  family = 'bernoulli',
```

```
                 seed = 1234)

Q1_NULL_2_LOO = loo(Q1_NULL_2)


Q1_NULL_2_COMP = loo_compare(Q1_NULL_2_LOO, Q1_NULL_2SCH_LOO)


#Step 2 - Consider intercept variance####

Q1_Mod_1a = brm(mvbind(X1, X2, X3 , X4 , X5, X6) ~ Time * exp_comp +
(1|School),

                 data = dfRq1,

                 seed = 1234)

summary(Q1_Mod_1a)

Q1_Mod_1a_LOO = loo(Q1_Mod_1a)


Step2_comp_a = loo_compare(Q1_NULL_1SCH_LOO, Q1_Mod_1a_LOO)


Q1_Mod_1b = brm(mvbind(X8, X9, X10) ~ Time * exp_comp + (1|School),

                 data = dfRq1,

                 family = 'bernoulli',

                 seed = 1234)

summary(Q1_Mod_1b)

Q1_Mod_1b_LOO = loo(Q1_Mod_1b)


Step2_comp_b = loo_compare(Q1_NULL_2SCH_LOO, Q1_Mod_1b_LOO)


#Step 3 - Investigate additional predictors####

Q1_Mod_2a = brm(mvbind(X1, X2, X3 , X4 , X5, X6) ~ Time * exp_comp + Time
* exp_comp * SEN  + Time * exp_comp * Gender + Time * exp_comp * EAL +
(~1|School),

                 data = dfRq1,

                 seed = 1234)

summary(Q1_Mod_2a) #Rhat ~1.0

Q1_Mod2a_LOO = loo(Q1_Mod_2a)
```

```
  Q1_Mod2a_KFOLD = kfold(Q1_Mod_2a, cores = 10)

  Q1_Mod2a_WAIC = waic(Q1_Mod_2a)


  Q1_Mod_2b = brm(mvbind(X8, X9, X10) ~ Time * exp_comp +
                    Time * exp_comp * SEN +
                    Time * exp_comp * Gender +
                    Time * exp_comp * EAL +
                    (~1|School),
                  data = df,
                  family = 'bernoulli',
                  seed = 1234)

  summary(Q1_Mod_2b) #Rhat ~1.0

  Q1_Mod2b_LOO = loo(Q1_Mod_2b)


  Step3_comp_a = loo_compare(Q1_Mod2a_LOO, q1mod2b)


#Research Q2 - "How are mindsets related to academic performance?"####

#Calculating mean and SD from Study 1 of Sisk, Burgoyne, Sun, Butler, and
Macnamara (2018)

#This gives an evidence based prior for subsequent models


#Formula from http://www.talkstats.com/threads/calculating-means-and-
standard-deviation-from-confidence-interval.2306/

#Checked with
http://www.socscistatistics.com/confidenceinterval/Default3.aspx


n = 365915 #From Pg 5

ci = c(0.09,0.14) # From Pg 6

x_bar = mean(ci) #Mean = 0.115

S = (ci[2]-ci[1])*sqrt(n)/(2*1.96) #Standard deviation = 7.71567709283074


#prior = set_prior('normal(0.115,7.71567709283074)')
```

```
#RQ2 - PHONICS####

#Create datafram with teh same number of cases across all analyses

dfRq2_phon = df[complete.cases(df[,c(4:6,8:13,15:18,21:23)]),]


  #Step 1 - examination of wihtin group variance####

  Q2_PhonMod_Null = brm(StdPhonics ~ 1,
                        data = dfRq2_phon,
                        seed = 1234)

  Q2_PhonMod_Null_LOO = loo(Q2_PhonMod_Null)


  Q2_PhonMod_NullG = brm(StdPhonics ~ 1 + (1|School),
                        data = dfRq2_phon,
                        seed = 1234)

  Q2_PhonMod_NullG_LOO = loo(Q2_PhonMod_NullG)


  Q2_Phon_NULL_Compare = loo_compare(Q2_PhonMod_Null_LOO,
Q2_PhonMod_NullG_LOO)


  #Step 2 - intercept variance####

  Q2_PhonMod_1 = brm(StdPhonics ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 +
X10 +
                       (1|School),
                     data = dfRq2_phon,
                     prior = set_prior('normal(0.115,7.71567709283074)'),
                     seed = 1234)

  summary(Q2_PhonMod_1)

  Q2_PhonMod_1_LOO = loo(Q2_PhonMod_1)


  Q2_Phon1Mod_1_NULL_COMP = loo_compare(Q2_PhonMod_1_LOO,
Q2_PhonMod_NullG_LOO)
```

```
#Step 3 - extra predictors####

Q2_PhonMod_2 = brm(StdPhonics ~

                   + X1 * Gender

                   + X2* Gender

                   + X3* Gender

                   + X4* Gender

                   + X5* Gender

                   + X6* Gender

                   + X8* Gender

                   + X9* Gender

                   + X10* Gender

                   + X1 * SEN

                   + X2* SEN

                   + X3* SEN

                   + X4* SEN

                   + X5* SEN

                   + X6* SEN

                   + X8* SEN

                   + X9* SEN

                   + X10* SEN

                   + X1 * EAL

                   + X2* EAL

                   + X3* EAL

                   + X4* EAL

                   + X5* EAL

                   + X6* EAL

                   + X8* EAL

                   + X9* EAL

                   + X10* EAL

                   + (1|School),
```

```
                          data = dfRq2_phon,
                          prior = set_prior('normal(0.115,7.71567709283074)'),
                          seed = 1234)
    summary(Q2_PhonMod_2) #Rhat ~1.0
    Q2_PhonMod_2_LOO = loo(Q2_PhonMod_2, reloo = T)


    Q2_PhonMod_1v2_COMP = loo_compare(Q2_PhonMod_1_LOO, Q2_PhonMod_2_LOO)
#Mod2 is better


    Q2_PhonMod_2a = brm(StdPhonics ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9
+ X10 +
                            SEN + EAL + Gender +
                            (1|School),
                          data = dfRq2_phon,
                          prior =
set_prior('normal(0.115,7.71567709283074)'))
    summary(Q2_PhonMod_2a) #Rhat ~1.0
    Q2_PhonMod_2a_LOO = loo(Q2_PhonMod_2a) # 97 unacceptable observations


    Q2_PhonMod_2_WAIC = waic(Q2_PhonMod_2)
    Q2_PhonMod_2a_WAIC = waic(Q2_PhonMod_2a)


    Q2_PhonMod_2v2a_COMP = loo_compare(Q2_PhonMod_2_WAIC,
Q2_PhonMod_2a_WAIC)
  #RQ2 - COMP####
  #Create dataframe to use on both models
  dfRq2_comp = df[complete.cases(df[,c(4:6,8:13,15:17,20:23)]),]


    #Step 1 - examination of wihtin group variance####
    Q2_CompMod_Null = brm(ReadComp ~ 1,
                            data = dfRq2_comp,
                            seed = 1234)
```

```
Q2_CompMod_Null_LOO = loo(Q2_CompMod_Null)


Q2_CompMod_NullG = brm(ReadComp ~ 1 + (1|School),
                       data = dfRq2_comp,
                       seed = 1234)
Q2_CompMod_NullG_LOO = loo(Q2_CompMod_NullG)


Q2_COMP_Null_compare = loo_compare(Q2_CompMod_Null_LOO,
Q2_CompMod_NullG_LOO)


#Step 2 - intercept variance####
Q2_CompMod_1 = brm(ReadComp ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 +
X10 +
                     (1|School),
                   data = dfRq2_comp,
                   prior = set_prior('normal(0.115,7.71567709283074)'))
Q2_CompMod_1_LOO = loo(Q2_CompMod_1)


Q2_CompMod_Nv1_COMP = loo_compare(Q2_CompMod_NullG_LOO,
Q2_CompMod_1_LOO)


summary(Q2_CompMod_1) #Rhat ~1.0


#Step 3 - aditional predictors####
Q2_CompMod_2 = brm(ReadComp ~
                   X1 * Gender
                   + X2* Gender
                   + X3* Gender
                   + X4* Gender
                   + X5* Gender
                   + X6* Gender
                   + X8* Gender
```

```
                    + X9* Gender
                    + X10* Gender
                    + X1 * SEN
                    + X2* SEN
                    + X3* SEN
                    + X4* SEN
                    + X5* SEN
                    + X6* SEN
                    + X8* SEN
                    + X9* SEN
                    + X10* SEN
                    + X1 * EAL
                    + X2* EAL
                    + X3* EAL
                    + X4* EAL
                    + X5* EAL
                    + X6* EAL
                    + X8* EAL
                    + X9* EAL
                    + X10* EAL
                    + (1|School),
                    data = dfRq2_comp,
                    prior = set_prior('normal(0.115,7.71567709283074)'),
                    seed = 1234)

Q2_CompMod_2_LOO = loo(Q2_CompMod_2, reloo = T)

Q2_CompMod_1vs2_COMP = loo_compare(Q2_CompMod_1_LOO, Q2_CompMod_2_LOO)

Q2_CompMod_2a = brm(ReadComp ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 +
X10 +
```

```
                        SEN + EAL + Gender +
                        (1|School),
                      data = dfRq2_comp,
                      prior =
set_prior('normal(0.115,7.71567709283074)'))


    Q2_CompMod_2a_LOO = loo(Q2_CompMod_2a)


    Q2_CompMod_2v2a_COMP = loo_compare(Q2_CompMod_2_LOO, Q2_CompMod_2a_LOO)


  #RQ2 - READING####
  #Produce dataframe with the same number of values across all analyses
  dfRq2_read = df[complete.cases(df[,c(4:6,8:13,15:17,19,21:23)]),]


    #Step 1 - examination of wihtin group variance####
    Q2_ReadMod_Null = brm(StdReading ~ 1,
                        data = dfRq2_read,
                        seed = 1234)
    Q2_ReadMod_Null_LOO = loo(Q2_ReadMod_Null)


    Q2_ReadMod_NullG = brm(StdReading ~ 1 + (1|School),
                         data = dfRq2_read,
                         seed = 1234)
    Q2_ReadMod_NullG_LOO = loo(Q2_ReadMod_NullG)


    Q2_ReadMod_Null_COMPARE = loo_compare(Q2_ReadMod_Null_LOO,
Q2_ReadMod_NullG_LOO)


    #Step 2 - intercept variance####
    Q2_ReadMod_1 = brm(StdReading ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 +
X10 +
                       (1|School),
```

```
                     data = dfRq2_read,
                     prior = set_prior('normal(0.115,7.71567709283074)'),
                     seed = 1234)
Q2_ReadMod_1_LOO = loo(Q2_ReadMod_1)

Q2_ReadMod_1vsNULL_COMPARE = loo_compare(Q2_ReadMod_NullG_LOO,
Q2_ReadMod_1_LOO)

summary(Q2_ReadMod_1) #Rhat ~1.0

#Step 3 - include other predictors####
Q2_ReadMod_2 = brm(StdReading ~
                     X1 * Gender
                     + X2* Gender
                     + X3* Gender
                     + X4* Gender
                     + X5* Gender
                     + X6* Gender
                     + X8* Gender
                     + X9* Gender
                     + X10* Gender
                     + X1 * SEN
                     + X2* SEN
                     + X3* SEN
                     + X4* SEN
                     + X5* SEN
                     + X6* SEN
                     + X8* SEN
                     + X9* SEN
                     + X10* SEN
                     + X1 * EAL
```

```
                     + X2* EAL
                     + X3* EAL
                     + X4* EAL
                     + X5* EAL
                     + X6* EAL
                     + X8* EAL
                     + X9* EAL
                     + X10* EAL
                     + (1|School),
                     data = dfRq2_read,
                     prior = set_prior('normal(0.115,7.71567709283074)'),
                     seed = 1234)
    Q2_ReadMod_2_LOO = loo(Q2_ReadMod_2)

    Q2_ReadMod_2v1_COMP = loo_compare(Q2_ReadMod_2_LOO, Q2_ReadMod_1_LOO)



    Q2_ReadMod_2a = brm(StdReading ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9
+ X10 +
                        SEN + EAL + Gender +
                        (1|School),
                      data = dfRq2_read,
                      prior =
set_prior('normal(0.115,7.71567709283074)'))
    Q2_ReadMod_2a_LOO = loo(Q2_ReadMod_2a)

    Q2_ReadMod_2v2a_COMP = loo_compare(Q2_ReadMod_2_LOO, Q2_ReadMod_2a_LOO)


#Research Q3 - "Does the intervention improve academic performance?"####
  #RQ3 - PHONICS####
  #Create datafram with the same number of cases across all analyses
```

```
dfRq3_phon = df[complete.cases(df[,c(4:7,8:13,15:18,21:23)]),]


#Step 1 - examination of wihtin group variance

#No need to repeat - same as RQ2


#Step 2 - intercept variance

Q3_PhonMod_1 = brm(StdPhonics ~
                     Time * exp_comp * X1 +
                     Time * exp_comp * X2 +
                     Time * exp_comp * X3 +
                     Time * exp_comp * X4 +
                     Time * exp_comp * X5 +
                     Time * exp_comp * X6 +
                     Time * exp_comp * X8 +
                     Time * exp_comp * X9 +
                     Time * exp_comp * X10 +
                     (1|School),
                   data = dfRq3_phon,
                   prior = set_prior('normal(0.115,7.71567709283074)'),
                   seed = 1234)
Q3_PhonMod_1_LOO = loo(Q3_PhonMod_1)


Q3_PhonMod_1vsN_COMP = loo_compare(Q2_PhonMod_NullG_LOO,
Q3_PhonMod_1_LOO)


summary(Q3_PhonMod_1)


#RQ3 - COMP####

dfRq3_comp = df[complete.cases(df[,c(4:7,8:13,15:17,20,21:23)]),]


#Step 1 - examination of wihtin group variance
```

```
Q3_CompMod_NullG = brm(ReadComp ~ 1 + (1|School),
                       data = dfRq3_comp,
                       seed = 1234)

#Step 2 - intercept variance
Q3_CompMod_1 = brm(ReadComp ~
                     Time * exp_comp * X1 +
                     Time * exp_comp * X2 +
                     Time * exp_comp * X3 +
                     Time * exp_comp * X4 +
                     Time * exp_comp * X5 +
                     Time * exp_comp * X6 +
                     Time * exp_comp * X8 +
                     Time * exp_comp * X9 +
                     Time * exp_comp * X10 +
                     (1|School),
                   data = dfRq3_comp,
                   prior = set_prior('normal(0.115,7.71567709283074)'),
                   seed = 1234)

Q3_CompMod_1_LOO = loo(Q3_CompMod_1) #Bad Pareto K

Q3_CompMod_1_WAIC = waic(Q3_CompMod_1)
Q3_CompMod_NullG_WAIC = waic(Q3_CompMod_NullG)
Q3_CompMod_1vN_COMP = loo_compare(Q3_CompMod_1_WAIC,
Q3_CompMod_NullG_WAIC)

summary(Q3_CompMod_1)

#RQ3 - READING####
dfRq3_read = df[complete.cases(df[,c(4:6,8:13,15:17,19,21:23)]),]
```

```
  #Step 1 - examination of wihtin group variance
  Q3_ReadMod_NullG = brm(ReadComp ~ 1 + (1|School),
                         data = dfRq3_read,
                         seed = 1234)
  Q3_ReadMod_NullG_WAIC = waic(Q3_ReadMod_NullG)


  #Step 2 - intercept variance
  Q3_ReadMod_1 = brm(ReadComp ~
                       Time * exp_comp * X1 +
                       Time * exp_comp * X2 +
                       Time * exp_comp * X3 +
                       Time * exp_comp * X4 +
                       Time * exp_comp * X5 +
                       Time * exp_comp * X6 +
                       Time * exp_comp * X8 +
                       Time * exp_comp * X9 +
                       Time * exp_comp * X10 +
                       (1|School/ID),
                     data = dfRq3_read,
                     prior = set_prior('normal(0.115,7.71567709283074)'),
                     seed = 1234)
  Q3_ReadMod_1_WAIC = waic(Q3_ReadMod_1)


  Q3_ReadMod_1vN_COMP = loo_compare(Q3_ReadMod_NullG_WAIC,
Q3_ReadMod_1_WAIC)


  summary(Q3_ReadMod_1)


#Research Q4 - "How does teacher engagement and mindset influence the
effectiveness of the intervention?"####
```

```
#Create difference scores dataframe####
df = df[order(df$ID, df$Time),]
diffdf = ddply(df,.(ID),transform,
               PhonDiff = StdPhonics-StdPhonics[1],
               ReadDiff = StdReading-StdReading[1],
               CompDiff = ReadComp-ReadComp[1],
               X1D = X1-X1[1],
               X2D = X2-X2[1],
               X3D = X3-X3[1],
               X4D = X4-X4[1],
               X5D = X5-X5[1],
               X6D = X6-X6[1],
               X8D = X8-X8[1],
               X9D = X9-X9[1],
               X10D = X10-X10[1]
)
diffdf = subset(diffdf, Time ==1 & exp_comp==1)
diffdf = filter(diffdf, School!="E")

#Check for MLM or LR####

#Question 1
Q4_null_1 = brm(X1 ~ 1,
                data = df,
                seed =1234)
Q4_null_1 = add_criterion(Q4_null_1, "loo")
Q4_null_1g = brm(X1 ~ 1 + (1|School),
                 data = df,
                 seed = 1234)
Q4_null_1g = add_criterion(Q4_null_1g, "loo")
```

```
loo(Q4_null_1, Q4_null_1g) #DO NOT USE grouping


#Question 2
Q4_null_2 = brm(X2 ~ 1,
                      data = df,
                      seed = 1234
              )
Q4_null_2 = add_criterion(Q4_null_2, "loo")
Q4_null_2g= brm(X2 ~ 1 + (1|School),
              data = df,
              seed = 1234)
Q4_null_2g = add_criterion(Q4_null_2g, "loo")
loo(Q4_null_2, Q4_null_2g) #DO NOT USE grouping


#Question 3
Q4_null_3 = brm(X3 ~ 1,
                data = df,
                seed = 1234
                )
Q4_null_3 = add_criterion(Q4_null_3, "loo")
Q4_null_3g = brm(X3 ~ 1 + (1|School),
                 data = df,
                 seed = 1234)
Q4_null_3g = add_criterion(Q4_null_3g, "loo")
loo(Q4_null_3, Q4_null_3g) # DO NOT USE groups


#Question 4
Q4_null_4 = brm(X4 ~ 1,
                data = df,
                seed = 1234
```

```
                )
Q4_null_4 = add_criterion(Q4_null_4, "loo")
Q4_null_4g = brm(X4 ~ 1 + (1|School),
                 data = df,
                 seed = 1234)
Q4_null_4g = add_criterion(Q4_null_4g, "loo")
loo(Q4_null_4, Q4_null_4g)#DO NOT USE GROUPS

#Question 5
Q4_null_5 = brm(X5 ~ 1,
                data = df,
                seed = 1234)
Q4_null_5 = add_criterion(Q4_null_5, "loo")
Q4_null_5g = brm(X5 ~ 1 + (1|School),
                 data = df,
                 seed = 1234)
Q4_null_5g = add_criterion(Q4_null_5g, "loo")
loo(Q4_null_5, Q4_null_5g) #DO NOT USE GROUPS

#Question 6
Q4_null_6 = brm(X6 ~ 1,
                data = df,
                seed = 1234)
Q4_null_6 = add_criterion(Q4_null_6, "loo")
Q4_null6g = brm(X6 ~ 1 + (1|School),
                data = df,
                seed = 1234)
Q4_null6g = add_criterion(Q4_null6g, "loo")
loo(Q4_null_6, Q4_null6g) #DO NOT USE GROUPS
```

```
#Question 8
Q4_null_8 = brm(X8 ~ 1,
                 data = df,
                 family = bernoulli(),
                 seed = 1234)
Q4_null_8 = add_criterion(Q4_null_8, "loo")
Q4_null_8g = brm(X8 ~ 1 + (1|School),
                 data = df,
                 family = bernoulli(),
                 )
Q4_null_8g = add_criterion(Q4_null_8g, "loo")
loo(Q4_null_8, Q4_null_8g) # DO NOT USE GROUPS

#Question 9
Q4_null_9 = brm(X9~1,
                data = df,
                family = bernoulli(),
                seed = 1234)
Q4_null_9 = add_criterion(Q4_null_9, "loo")
Q4_null_9g = brm(X9 ~ 1 + (1|School),
                 data = df,
                 family = bernoulli(),
                 seed = 1234)
Q4_null_9g = add_criterion(Q4_null_9g, "loo")
loo(Q4_null_9, Q4_null_9g) # DO NOT USE GROUPS

#Question 10
Q4_null_10 = brm(X10 ~ 1,
                 data = df,
                 family = bernoulli(),
```

```
                  seed = 1234)

  Q4_null_10 = add_criterion(Q4_null_10, "loo")

  Q4_null_10g = brm(X10 ~ 1 + (1|School),

                   data = df,

                   family = bernoulli(),

                   seed =1234)

  Q4_null_10g = add_criterion(Q4_null_10g, "loo")

  Q4_null_10_loo = loo(Q4_null_10,Q4_null_10g) # DO NOT USE GROUPS


        ##Explore teacher/school culture


  Q4_1 = brm(X1 ~ Time*sch_mastery_goals + Time*sch_perfm_goals +
Time*mastery_inst + Time*pupil_dweck

             + Time*teaching_eff + Time*dweck_self,

             data = df)


  #Regressions####

  wide = read.csv("MAKE_WIDE.csv")

  #Q8####

  PP <- c(prior(student_t(3, 0, 2.5), class = "Intercept"),

    prior(student_t(3, 0, 2.5), class = "b")

  )

  Q8_Verb = brm(X8T1 ~ X8T0 + verbal_FBT1,

                data = wide,

                family = "bernoulli",

                seed = 1234

  )

  Q8_written = brm(X8T1 ~ X8T0 + as.factor(written_FBT1),

                data = wide,

                prior = PP,

                family = "bernoulli",
```

```
              seed = 1234
)
Q8_music = brm(X8T1 ~ X8T0 + as.factor(musicT1),
              data = wide,
              prior = PP,
              family = "bernoulli",
              seed = 1234
)
Q8_books = brm(X8T1 ~ X8T0 + as.factor(booksT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)
Q8_focus = brm(X8T1 ~ X8T0 + as.factor(focus_pracT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)
Q8_dojo = brm(X8T1 ~ X8T0 + as.factor(dojoT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)
Q8_displays = brm(X8T1 ~ X8T0 + as.factor(displaysT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
```

```
                seed = 1234
)
Q8_discussions = brm(X8T1 ~ X8T0 + as.factor(discussionsT1),
                data = wide,
                prior = PP,
                family = "bernoulli",
                seed = 1234
)
summary(Q8_Verb)
summary(Q8_written)
summary(Q8_music)
summary(Q8_books)
summary(Q8_focus)
summary(Q8_dojo)
summary(Q8_displays)
summary(Q8_discussions)
marginal_effects(Q8_music)

#Q9####
Q9_Verb = brm(X9T1 ~ X9T0 + as.factor(verbal_FBT1),
              data = wide,
              prior = PP,
              family = "bernoulli",
              seed = 1234
)

Q9_written = brm(X9T1 ~ X9T0 + as.factor(written_FBT1),
                 data = wide,
                 prior = PP,
                 family = "bernoulli",
```

```
                 seed = 1234
)

Q9_music = brm(X9T1 ~ X9T0 + as.factor(musicT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)

Q9_books = brm(X9T1 ~ X9T0 + as.factor(booksT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)

Q9_focus = brm(X9T1 ~ X9T0 + as.factor(focus_pracT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)
Q9_dojo = brm(X9T1 ~ X9T0 + as.factor(dojoT1),
              data = wide,
              prior = PP,
              family = "bernoulli",
              seed = 1234
)
Q9_displays = brm(X9T1 ~ X9T0 + as.factor(displaysT1),
```

```
                  data = wide,
                  prior = PP,
                  family = "bernoulli",
                  seed = 1234
)
Q9_discussions = brm(X9T1 ~ X9T0 + as.factor(discussionsT1),
                     data = wide,
                     prior = PP,
                     family = "bernoulli",
                     seed = 1234
)
summary(Q9_Verb)
summary(Q9_written)
summary(Q9_music)
summary(Q9_books)
summary(Q9_focus)
summary(Q9_dojo)
summary(Q9_displays)
summary(Q9_discussions)

#Q10####
Q10_Verb = brm(X10T1 ~ X10T0 + as.factor(verbal_FBT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)

Q10_written = brm(X10T1 ~ X10T0 + as.factor(written_FBT1),
                  data = wide,
```

```
                 prior = PP,
                 family = "bernoulli",
                 seed = 1234
)

Q10_music = brm(X10T1 ~ X10T0 + as.factor(musicT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)

Q10_books = brm(X10T1 ~ X10T0 + as.factor(booksT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)

Q10_focus = brm(X10T1 ~ X10T0 + as.factor(focus_pracT1),
               data = wide,
               prior = PP,
               family = "bernoulli",
               seed = 1234
)
Q10_dojo = brm(X10T1 ~ X10T0 + as.factor(dojoT1),
              data = wide,
              prior = PP,
              family = "bernoulli",
              seed = 1234
```

```
  )
  Q10_displays = brm(X10T1 ~ X10T0 + as.factor(displaysT1),
                     data = wide,
                     prior = PP,
                     family = "bernoulli",
                     seed = 1234
  )
  Q10_discussions = brm(X10T1 ~ X10T0 + as.factor(discussionsT1),
                        data = wide,
                        prior = PP,
                        family = "bernoulli",
                        seed = 1234
  )
  summary(Q10_Verb)
  summary(Q10_written)
  summary(Q10_music)
  summary(Q10_books)
  summary(Q10_focus)
  summary(Q10_dojo)
  summary(Q10_displays)
  summary(Q10_discussions)
#Research Q5 - "ARe teacher mindsets influenced by using the
intervention?"####
  wide = read.csv("MAKE_WIDE.csv")
  brm(X1 ~ Time + Time * sch_mastery_goals,
      data = df,
      family = 'cumulative',
      seed = 1234)


#Research Q6 - Is pupil aspiration related to their growth mindset?####
dfRq6 = df[which(df$X7<=9),]
```

```
dfRq6_A = dfRq6[complete.cases(dfRq6[,c(2,7:16,21)]),]

multi.hist(dfRq6_A[,c(7:16)], main = "", nrow =3,freq=F, density = F)

#Step 1 - examination of within group variance
Q6_NULL = brm(X7 ~ 1,
              data = dfRq6,
              seed = 1234)

kfold(Q6_NULL, cores = 8, k = 10)

Q6_NULLG = brm(X7 ~ 1 + (1|School/ID),
               data = dfRq6,
               seed = 1234,
               chains = 8)

kfold(Q6_NULLG, cores = 8, K = 10)

#Step 2 - intercept variance
Q6_Mod_1 = brm(X7 ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 + X10 +
                (1|School/ID),
              data = dfRq6_A,
              family = 'cumulative',
              seed = 1234,
              control = list(adapt_delta = 0.99),
              chains = 8)
summary(Q6_Mod_1) #Rhat ~1.0
plot(Q6_Mod_1) #Hairy caterpillars?
pp = brms::pp_check(Q6_Mod_1)
pp + theme_bw()#Concurrent lines
```

```
marginal_effects(Q6_Mod_1)


kfold(Q6_Mod_1, cores = 8, K = 10)


#Step 3 - Slope variance
Q6_Mod_2 = brm(X7 ~ X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 + X10 +
                 (X1 + X2 + X3 + X4 + X5 + X6 + X8 + X9 + X10|School/ID),
               data = dfRq6_A,
               family = 'cumulative',
               control = list(adapt_delta = 0.99),
               seed = 1234,
               chains = 8)
summary(Q6_Mod_2) #Rhat ~1.0
plot(Q6_Mod_2) #Hairy caterpillars?
pp = brms::pp_check(Q6_Mod_2)
pp + theme_bw()#Concurrent lines
marginal_effects(Q6_Mod_2)


                     kfold(Q6_Mod_2, cores = 8, K = 10)


#SEM code####
# Load pupil data and standaridised score tables
SEMdf = read.csv('RPTdata.csv', na.strings = c('','NA'))


#correct column title
names(SEMdf)[1] ="Age"


  #Recode  and setup variables####
SEMdf$NS_Learn_Q2 = car::recode(SEMdf$NS_Learn_Q2,
'6=1;5=2;4=3;3=4;2=5;1=6')
```

```
SEMdf$NS_Fail_Aff_Q3 = car::recode(SEMdf$NS_Fail_Aff_Q3,
'6=1;5=2;4=3;3=4;2=5;1=6')

SEMdf$NS_Fail_Pers_Q4 = car::recode(SEMdf$NS_Fail_Pers_Q4,
'6=1;5=2;4=3;3=4;2=5;1=6')

SEMdf$NS_TOI_Q8 = car::recode(SEMdf$NS_TOI_Q8, '2=0')

SEMdf$NS_TOI_Q9 = car::recode(SEMdf$NS_TOI_Q9, '2=0')

SEMdf$NS_TOI_Q10 = car::recode(SEMdf$NS_TOI_Q10, '2=0')

SEMdf$NS_TOI_Q8 = car::recode(SEMdf$NS_TOI_Q8, '1=0;0=1')


SEMdf$Dweck_TOI_Q2 = car::recode(SEMdf$Dweck_TOI_Q2,
'6=1;5=2;4=3;3=4;2=5;1=6')

SEMdf$Dweck_TOI_Q5 = car::recode(SEMdf$Dweck_TOI_Q5,
'6=1;5=2;4=3;3=4;2=5;1=6')

SEMdf$Dweck_TOI_Q6 = car::recode(SEMdf$Dweck_TOI_Q6,
'6=1;5=2;4=3;3=4;2=5;1=6')


SEMdf$GD_Outcome_Q1 = car::recode(SEMdf$GD_Outcome_Q1,
'7=1;6=2;5=3;3=5;2=6;1=7')

SEMdf$GD_Outcome_Q2 = car::recode(SEMdf$GD_Outcome_Q2,
'7=1;6=2;5=3;3=5;2=6;1=7')

SEMdf$GD_Outcome_Q3 = car::recode(SEMdf$GD_Outcome_Q3,
'7=1;6=2;5=3;3=5;2=6;1=7')


SEMdf$GD_Ability_Q1 = car::recode(SEMdf$GD_Ability_Q1,
'7=1;6=2;5=3;3=5;2=6;1=7')

SEMdf$GD_Ability_Q2 = car::recode(SEMdf$GD_Ability_Q2,
'7=1;6=2;5=3;3=5;2=6;1=7')

SEMdf$GD_Ability_Q3 = car::recode(SEMdf$GD_Ability_Q3,
'7=1;6=2;5=3;3=5;2=6;1=7')


SEMdf$Bwell_strat_Q1 = car::recode(SEMdf$Bwell_strat_Q1,
'6=1;5=2;4=3;3=4;2=5;1=6')

SEMdf$Bwell_strat_Q2 = car::recode(SEMdf$Bwell_strat_Q2,
'6=1;5=2;4=3;3=4;2=5;1=6')
```

```
SEMdf$Dweck_TOI6 = SEMdf$Dweck_TOI_Q1 + SEMdf$Dweck_TOI_Q2 +
SEMdf$Dweck_TOI_Q3 + SEMdf$Dweck_TOI_Q4 + SEMdf$Dweck_TOI_Q5 +
SEMdf$Dweck_TOI_Q6

SEMdf$GD_outcome = SEMdf$GD_Outcome_Q1 + SEMdf$GD_Outcome_Q2 +
SEMdf$GD_Outcome_Q3

SEMdf$GD_ability = SEMdf$GD_Ability_Q1 + SEMdf$GD_Ability_Q2 +
SEMdf$GD_Ability_Q3

SEMdf$GD_learn = SEMdf$GD_Learn_Q1 + SEMdf$GD_Learn_Q2 + SEMdf$GD_Learn_Q3

SEMdf$GD_mast = SEMdf$GD_Mast_Q1 + SEMdf$GD_Mast_Q2 + SEMdf$GD_Mast_Q3

SEMdf$Bwell_helpless = SEMdf$Bwell_Fail_Q1 + SEMdf$Bwell_Fail_Q2 +
SEMdf$Bwell_Fail_Q3 + SEMdf$Bwell_Fail_Q4

SEMdf$Bwell_positive = SEMdf$Bwell_strat_Q4 + SEMdf$Bwell_strat_Q5 +
SEMdf$Bwell_strat_Q6

SEMdf$Effort = SEMdf$Bwell_strat_Q1 + SEMdf$Bwell_strat_Q2


  #Summary stats####

  Demos = ddply(SEMdf, .(), summarise,

                N = length(Age),

                NotSayPerc = length(Gender[Gender==1])/length(Gender)*100,

                FemalePerc = length(Gender[Gender==2])/length(Gender)*100,

                MalesPerc = length(Gender[Gender==3])/length(Gender)*100,

                TransPerc = length(Gender[Gender==4])/length(Gender)*100,

                AgeMean = mean(Age, na.rm = T),

                AgeSD = sd(Age, na.rm = T),

                AgeMin = min(Age),

                AgeMax = max(Age),


                NS_Perf_Q1_N = length(NS_Perf_Q1[!is.na(NS_Perf_Q1)]),

                NS_Perf_Q1_M = mean(NS_Perf_Q1, na.rm = T),

                NS_Perf_Q1_sd = sd(NS_Perf_Q1, na.rm = T),

                NS_Perf_Q1_se = NS_Perf_Q1_sd / sqrt(NS_Perf_Q1_N),

                NS_Perf_Q1_LowCI = NS_Perf_Q1_M +
qnorm(0.025)*NS_Perf_Q1_se,
```

```
                    NS_Perf_Q1_HighCI = NS_Perf_Q1_M +
qnorm(0.975)*NS_Perf_Q1_se,


                    NS_Learn_Q2_N = length(NS_Learn_Q2[!is.na(NS_Learn_Q2)]),

                    NS_Learn_Q2_M = mean(NS_Learn_Q2, na.rm = T),

                    NS_Learn_Q2_sd = sd(NS_Learn_Q2, na.rm = T),

                    NS_Learn_Q2_se = NS_Learn_Q2_sd / sqrt(NS_Learn_Q2_N),

                    NS_Learn_Q2_LowCI = NS_Learn_Q2_M +
qnorm(0.025)*NS_Learn_Q2_se,

                    NS_Learn_Q2_HighCI = NS_Learn_Q2_M +
qnorm(0.975)*NS_Learn_Q2_se,


                    NS_Fail_Aff_Q3_N =
length(NS_Fail_Aff_Q3[!is.na(NS_Fail_Aff_Q3)]),

                    NS_Fail_Aff_Q3_M = mean(NS_Fail_Aff_Q3, na.rm = T),

                    NS_Fail_Aff_Q3_sd = sd(NS_Fail_Aff_Q3, na.rm = T),

                    NS_Fail_Aff_Q3_se = NS_Fail_Aff_Q3_sd /
sqrt(NS_Fail_Aff_Q3_N),

                    NS_Fail_Aff_Q3_LowCI = NS_Fail_Aff_Q3_M +
qnorm(0.025)*NS_Fail_Aff_Q3_se,

                    NS_Fail_Aff_Q3_HighCI = NS_Fail_Aff_Q3_M +
qnorm(0.975)*NS_Fail_Aff_Q3_se,


                    NS_Fail_Pers_Q4_N =
length(NS_Fail_Pers_Q4[!is.na(NS_Fail_Pers_Q4)]),

                    NS_Fail_Pers_Q4_M = mean(NS_Fail_Pers_Q4, na.rm = T),

                    NS_Fail_Pers_Q4_sd = sd(NS_Fail_Pers_Q4, na.rm = T),

                    NS_Fail_Pers_Q4_se = NS_Fail_Pers_Q4_sd /
sqrt(NS_Fail_Pers_Q4_N),

                    NS_Fail_Pers_Q4_LowCI = NS_Fail_Pers_Q4_M +
qnorm(0.025)*NS_Fail_Pers_Q4_se,

                    NS_Fail_Pers_Q4_HighCI = NS_Fail_Pers_Q4_M +
qnorm(0.975)*NS_Fail_Pers_Q4_se,


                    NS_Succ_Aff_Q5_N =
length(NS_Succ_Aff_Q5[!is.na(NS_Succ_Aff_Q5)]),
```

```
                NS_Succ_Aff_Q5_M = mean(NS_Succ_Aff_Q5, na.rm = T),

                NS_Succ_Aff_Q5_sd = sd(NS_Succ_Aff_Q5, na.rm = T),

                NS_Succ_Aff_Q5_se = NS_Succ_Aff_Q5_sd /
sqrt(NS_Succ_Aff_Q5_N),

                NS_Succ_Aff_Q5_LowCI = NS_Succ_Aff_Q5_M +
qnorm(0.025)*NS_Succ_Aff_Q5_se,

                NS_Succ_Aff_Q5_HighCI = NS_Succ_Aff_Q5_M +
qnorm(0.975)*NS_Succ_Aff_Q5_se,


                NS_Succ_Pers_Q6_N =
length(NS_Succ_Pers_Q6[!is.na(NS_Succ_Pers_Q6)]),

                NS_Succ_Pers_Q6_M = mean(NS_Succ_Pers_Q6, na.rm = T),

                NS_Succ_Pers_Q6_sd = sd(NS_Succ_Pers_Q6, na.rm = T),

                NS_Succ_Pers_Q6_se = NS_Succ_Pers_Q6_sd /
sqrt(NS_Succ_Pers_Q6_N),

                NS_Succ_Pers_Q6_LowCI = NS_Succ_Pers_Q6_M +
qnorm(0.025)*NS_Succ_Pers_Q6_se,

                NS_Succ_Pers_Q6_HighCI = NS_Succ_Pers_Q6_M +
qnorm(0.975)*NS_Succ_Pers_Q6_se,


                NS_Q8_Perc =
length(NS_TOI_Q8[NS_TOI_Q8==1])/length(NS_TOI_Q8)*100,

                NS_Q8_Count = length(NS_TOI_Q8[NS_TOI_Q8==1]),


                NS_Q9_Perc =
length(NS_TOI_Q9[NS_TOI_Q9==1])/length(NS_TOI_Q9)*100,

                NS_Q9_Count = length(NS_TOI_Q9[NS_TOI_Q9==1]),


                NS_Q10_Perc =
length(NS_TOI_Q10[NS_TOI_Q10==1])/length(NS_TOI_Q10)*100,

                NS_Q10_Count = length(NS_TOI_Q10[NS_TOI_Q10==1]),


                Dweck_TOI6_N = length(Dweck_TOI6[!is.na(Dweck_TOI6)]),

                Dweck_TOI6_M = mean(Dweck_TOI6, na.rm = T),

                Dweck_TOI6_sd = sd(Dweck_TOI6, na.rm = T),
```

```
                    Dweck_TOI6_se = Dweck_TOI6_sd / sqrt(Dweck_TOI6_N),

                    Dweck_TOI6_LowCI = Dweck_TOI6_M +
qnorm(0.025)*Dweck_TOI6_se,

                    Dweck_TOI6_HighCI = Dweck_TOI6_M +
qnorm(0.975)*Dweck_TOI6_se,


                    GD_outcome_N = length(GD_outcome[!is.na(GD_outcome)]),

                    GD_outcome_M = mean(GD_outcome, na.rm = T),

                    GD_outcome_sd = sd(GD_outcome, na.rm = T),

                    GD_outcome_se = GD_outcome_sd / sqrt(GD_outcome_N),

                    GD_outcome_LowCI = GD_outcome_M +
qnorm(0.025)*GD_outcome_se,

                    GD_outcome_HighCI = GD_outcome_M +
qnorm(0.975)*GD_outcome_se,


                    GD_ability_N = length(GD_ability[!is.na(GD_ability)]),

                    GD_ability_M = mean(GD_ability, na.rm = T),

                    GD_ability_sd = sd(GD_ability, na.rm = T),

                    GD_ability_se = GD_ability_sd / sqrt(GD_ability_N),

                    GD_ability_LowCI = GD_ability_M +
qnorm(0.025)*GD_ability_se,

                    GD_ability_HighCI = GD_ability_M +
qnorm(0.975)*GD_ability_se,


                    GD_learn_N = length(GD_learn[!is.na(GD_learn)]),

                    GD_learn_M = mean(GD_learn, na.rm = T),

                    GD_learn_sd = sd(GD_learn, na.rm = T),

                    GD_learn_se = GD_learn_sd / sqrt(GD_learn_N),

                    GD_learn_LowCI = GD_learn_M + qnorm(0.025)*GD_learn_se,

                    GD_learn_HighCI = GD_learn_M + qnorm(0.975)*GD_learn_se,


                    GD_mast_N = length(GD_mast[!is.na(GD_mast)]),

                    GD_mast_M = mean(GD_mast, na.rm = T),
```

```
                GD_mast_sd = sd(GD_mast, na.rm = T),

                GD_mast_se = GD_mast_sd / sqrt(GD_mast_N),

                GD_mast_LowCI = GD_mast_M + qnorm(0.025)*GD_mast_se,

                GD_mast_HighCI = GD_mast_M + qnorm(0.975)*GD_mast_se,


                Bwell_helpless_N =
length(Bwell_helpless[!is.na(Bwell_helpless)]),

                Bwell_helpless_M = mean(Bwell_helpless, na.rm = T),

                Bwell_helpless_sd = sd(Bwell_helpless, na.rm = T),

                Bwell_helpless_se = Bwell_helpless_sd /
sqrt(Bwell_helpless_N),

                Bwell_helpless_LowCI = Bwell_helpless_M +
qnorm(0.025)*Bwell_helpless_se,

                Bwell_helpless_HighCI = Bwell_helpless_M +
qnorm(0.975)*Bwell_helpless_se,


                Bwell_positive_N =
length(Bwell_positive[!is.na(Bwell_positive)]),

                Bwell_positive_M = mean(Bwell_positive, na.rm = T),

                Bwell_positive_sd = sd(Bwell_positive, na.rm = T),

                Bwell_positive_se = Bwell_positive_sd /
sqrt(Bwell_positive_N),

                Bwell_positive_LowCI = Bwell_positive_M +
qnorm(0.025)*Bwell_positive_se,

                Bwell_positive_HighCI = Bwell_positive_M +
qnorm(0.975)*Bwell_positive_se,


                Effort_N = length(Effort[!is.na(Effort)]),

                Effort_M = mean(Effort, na.rm = T),

                Effort_sd = sd(Effort, na.rm = T),

                Effort_se = Effort_sd / sqrt(Effort_N),

                Effort_LowCI = Effort_M + qnorm(0.025)*Effort_se,

                Effort_HighCI = Effort_M + qnorm(0.975)*Effort_se
```

```
)

write.csv(Demos, file = "Demos.csv")

#GLB, alphas, FA, etc.####
scaleStructure(dat = SEMdf[12:17], digits = 3, ci = T, samples = 1000, omega.psych = T) #Dweck_TOI
scaleStructure(dat = SEMdf[18:20], digits = 3, ci = T, samples = 1000, omega.psych = T) #GD_outcome
scaleStructure(dat = SEMdf[21:23], digits = 3, ci = T, samples = 1000, omega.psych = T) #GD_ability
scaleStructure(dat = SEMdf[24:26], digits = 3, ci = T, samples = 1000, omega.psych = T) #GD_learn
scaleStructure(dat = SEMdf[27:29], digits = 3, ci = T, samples = 1000, omega.psych = T) #GD_mast
scaleStructure(dat = SEMdf[30:33], digits = 3, ci = T, samples = 1000, omega.psych = T) # Bwell_helpless
scaleStructure(dat = SEMdf[37:39], digits = 3, ci = T, samples = 1000, omega.psych = T) # Bwell_strat
scaleStructure(dat = SEMdf[34:35], digits = 3, ci = T, samples = 1000, omega.psych = T) #Effort

#Histograms####
histSEMdf = SEMdf[,c(3:11,40:47)]
names(histSEMdf)[1] = "Performance_goal_Q1"
names(histSEMdf)[2] = "Learning_goal_Q2"
names(histSEMdf)[3] = "Failure_affect_Q3"
names(histSEMdf)[4] = "Failure_persistence_Q4"
names(histSEMdf)[5] = "Success_affect_Q5"
names(histSEMdf)[6] = "Success_persistence_Q6"
names(histSEMdf)[7] = "Essentialism_Q8"
names(histSEMdf)[8] = "Mindset_others_Q9"
names(histSEMdf)[9] = "Mindset_self_Q10"
names(histSEMdf)[10] = "Dweck_ToI_Q11-Q16"
```

```
names(histSEMdf)[11] = "Outcome_goal_Q17-Q19"

names(histSEMdf)[12] = "Ability_goal_Q20-Q22"

names(histSEMdf)[13] = "Learning_goal_Q23-Q25"

names(histSEMdf)[14] = "Change_mastery_Q26-Q28"

names(histSEMdf)[15] = "Helpless_attribution_Q29-Q32"

names(histSEMdf)[16] = "Positive_strategies_Q33-Q35"

names(histSEMdf)[17] = "Effort_beliefs-Q36-Q37"


multi.hist(histSEMdf, ncol = 3)


#Create dataframe of just full instruments (no items) for JASP (network
analysis)

instSEMdf = SEMdf[,c(1:11,40:47)]

names(instSEMdf)[3] = "Performance_goal_Q1"

names(instSEMdf)[4] = "Learning_goal_Q2"

names(instSEMdf)[5] = "Failure_affect_Q3"

names(instSEMdf)[6] = "Failure_persistence_Q4"

names(instSEMdf)[7] = "Success_affect_Q5"

names(instSEMdf)[8] = "Success_persistence_Q6"

names(instSEMdf)[9] = "Essentialism_Q8"

names(instSEMdf)[10] = "Mindset_others_Q9"

names(instSEMdf)[11] = "Mindset_self_Q10"

names(instSEMdf)[12] = "Dweck_ToI_Q11-Q16"

names(instSEMdf)[13] = "Outcome_goal_Q17-Q19"

names(instSEMdf)[14] = "Ability_goal_Q20-Q22"

names(instSEMdf)[15] = "Learning_goal_Q23-Q25"

names(instSEMdf)[16] = "Change_mastery_Q26-Q28"

names(instSEMdf)[17] = "Helpless_attribution_Q29-Q32"

names(instSEMdf)[18] = "Positive_strategies_Q33-Q35"

names(instSEMdf)[19] = "Effort_beliefs-Q36-Q37"
```

```
write.csv(instSEMdf, file = "INSTS_JASP.csv")


#New data set with square root for normality


#Blackwell replication####
#First model - original in thesis
SEM_RPT1 = '
  #measurement
          IT =~ Dweck_TOI_Q1 + Dweck_TOI_Q2 + Dweck_TOI_Q3 +
Dweck_TOI_Q4 + Dweck_TOI_Q5
               + Dweck_TOI_Q6
          EF =~ Bwell_strat_Q1 + Bwell_strat_Q2
          LG =~ GD_Learn_Q1 + GD_Learn_Q2 + GD_Learn_Q3
          HA =~ Bwell_Fail_Q1 + Bwell_Fail_Q2 + Bwell_Fail_Q3 +
Bwell_Fail_Q4
          PS =~ Bwell_strat_Q4 + Bwell_strat_Q5 + Bwell_strat_Q6
  #regressions
      PS ~ HA + EF + LG
      LG ~ IT
      EF ~ IT
      HA ~ EF
'
SEMmodel1 = sem(SEM_RPT1, data = SEMdf, likelihood = "wishart", estimator
= "MLR")
summary(SEMmodel1, standardized = T, fit.measures = T)


regs_save = parameterEstimates(SEMmodel1, standardized = T, ci = F)
cols = sapply(regs_save, is.numeric)
regs_save[, cols] = round(regs_save[,cols],3)
write.table(regs_save, file="regressions.csv", col.names = T, row.names =
F, sep = ",")
summaryoutput_SEM = fitMeasures(SEMmodel1)
```

```
summaryoutput_SEM = as.data.frame(summaryoutput_SEM)

summaryoutput_SEM = round(summaryoutput_SEM, 3)


#Realised that missing that in Figure 2. caption from Blackwell et al.
(2007)

#They covaried learning goals and positive effort beliefs - not included

#SEM_RPT1 - has been excluded from the thesis and updated with SEM_RPT2


SEM_RPT2 = '

  #measurement

            IT =~ Dweck_TOI_Q1 + Dweck_TOI_Q2 + Dweck_TOI_Q3 +
Dweck_TOI_Q4 + Dweck_TOI_Q5

                 + Dweck_TOI_Q6

            EF =~ Bwell_strat_Q1 + Bwell_strat_Q2

            LG =~ GD_Learn_Q1 + GD_Learn_Q2 + GD_Learn_Q3

            HA =~ Bwell_Fail_Q1 + Bwell_Fail_Q2 + Bwell_Fail_Q3 +
Bwell_Fail_Q4

            PS =~ Bwell_strat_Q4 + Bwell_strat_Q5 + Bwell_strat_Q6

  #regressions

       PS ~ HA + EF + LG

       LG ~ IT

       EF ~ IT

       HA ~ EF

  #Covariance

       LG ~~ EF

'

SEMmodel2 = sem(SEM_RPT2, data = SEMdf, likelihood = "wishart", estimator
= "MLR")

summary(SEMmodel2, standardized = T, fit.measures = T)


#Fit still not acceptable (RCFI = .885, RMSEA = 0.083, SRMR = 0.088)
```

```
mod_ind_SEM2 = modificationindices(SEMmodel2)

head(mod_ind_SEM2[order(mod_ind_SEM2$mi, decreasing = T), ], 10)

write.csv(mod_ind_SEM2, "mod_ind_SEM2.csv")


#Negatively worded items in Dweck ToI instrument (Q5&6 particularly) have
big MI

#are conceptually related - model covariance


SEM_RPT3 = '

  #measurement

            IT =~ Dweck_TOI_Q1 + Dweck_TOI_Q2 + Dweck_TOI_Q3 +
Dweck_TOI_Q4 + Dweck_TOI_Q5

                 + Dweck_TOI_Q6

            EF =~ Bwell_strat_Q1 + Bwell_strat_Q2

            LG =~ GD_Learn_Q1 + GD_Learn_Q2 + GD_Learn_Q3

            HA =~ Bwell_Fail_Q1 + Bwell_Fail_Q2 + Bwell_Fail_Q3 +
Bwell_Fail_Q4

            PS =~ Bwell_strat_Q4 + Bwell_strat_Q5 + Bwell_strat_Q6

  #regressions

       PS ~ HA + EF + LG

       LG ~ IT

       EF ~ IT

       HA ~ EF

  #Covariance

       LG ~~ EF

       Dweck_TOI_Q6 ~~ Dweck_TOI_Q5

       Dweck_TOI_Q6 ~~ Dweck_TOI_Q2

       Dweck_TOI_Q5 ~~ Dweck_TOI_Q2

'

SEMmodel3 = sem(SEM_RPT3, data = SEMdf, likelihood = "wishart", estimator
= "MLR")

summary(SEMmodel3, standardized = T, fit.measures = T)
```

Appendix D - Head teacher letter – initial instrument trialling

City of
Stoke-on-Trent

DATE

Dear (insert name)

My name is Nick Garnett and I am Postgraduate Research Student working with Dr Yvonne Skipper in the School of Psychology at Keele University. We are working with the Stoke Reads programme to investigate how children think about intelligence. I am writing to you today to ask if you and your school would be willing to participate in some exciting research we are carrying out.

What is the background and aim of this research?
Professor Carol Dweck's research has indicated that an individual may view intelligence as a fixed attribute or something which they can grow over time. These are commonly referred to as fixed or growth mindsets. Previous research has shown that even very young children hold these views, however this research involved long interviews and intensive observations with young children. The aim of our research is to produce some simple tools which should capture this information much more quickly and easily. We have developed a series of questions designed to access young children's views of intelligence. These questions need to be trialled with a broad selection of children to ensure they are appropriate for use with all young children. We would like to work with one Reception class and one Year 1 class and trial our questions with them. This should take around 10 minutes. We would like to trial the same questions at three different times to examine whether children's answers remain the same or change over time. We would ask the school to create anonymous identifying codes for the children so that the data remain anonymous but we can match their answers at different times.

How will you gain consent?
Initially we require your *loco parentis* consent for the project to take place in your school. We would then write to parents via a letter sent home with their children to gain their consent for this to take place. This letter would be of an opt-out format, in that parents should respond to withdraw their consent. Even if parents initially consent to their child participating, they can change their mind at a later point. If they do withdraw consent, we will ask them to contact your school directly so that you can inform us of their child's anonymous identifier. After we have finished trialling our questions in school it will only be possible to withdraw data from the project for *two* weeks following the final testing date. Any data which is removed will be destroyed/deleted from databases. After this time, data will be used in analysing the success of our measures.

We will also give the children an opportunity to decide on the day whether to participate or not and make it clear that they can stop the study at any time without giving a reason and refuse to answer any question. However, most children enjoy the opportunity to give their opinions about their learning.

What will happen during this project?
Researchers from Keele University would come into school and trial the measures with individual pupils at a time which is convenient for your school. Ideally this would take place away from the classroom, or in a quiet corner of it. We would then visit the pupils again after 2 and then 6 weeks to see if their views had changed over time. The trials will take no more than 10 minutes of your pupil's time to complete on each occasion. We intend for there to be minimal disruption to the normal operation of the classroom and would discuss the best way to achieve this with your class teachers. We would ask that the class teacher assigns each pupil a 'code' so that we can follow each child across the 3 time points whilst maintaining their anonymity. It is our intention that there would be minimal input required from your teachers throughout this process.

What types of questions will be asked?
We are interested in younger pupil's views on aspiration, intelligence, whether they like to correct mistakes and if they want to develop their skills. We will ask questions such as "What do you want to be when you grow up?" and "You have made a mistake on this drawing but not the other, which one would you like to draw again?" and "Would you like to do hard or easy maths questions?".

What will happen to this data?
All the data collected will be anonymous and no identifying information will be collected about your pupils or school. This data will be used to ensure that the questions we are asking children are appropriate for their age range. We may publish articles which discuss this research, however your school, pupils and teachers will remain anonymous and only general trends will be reported, no individuals will be identified.

I am sure you will have questions about participating in the research and I will phone the school next week to discuss the research in more detail with you. If you require more information, or wish to be in touch sooner, please do not hesitate to contact me (information below).

Many thanks for taking the time to read this letter,

Yours sincerely,

Nick Garnett
Postgraduate Research Student
School of Psychology
Dorothy Hodgkin Building
Keele University
ST5 5BG
T: 01782 734402
E: n.j.garnett@keele.ac.uk

If you are unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Nicola Leighton who is the University's contact for complaints regarding research at the following address:-

Nicola Leighton
Research Governance Officer
Research & Enterprise Services
Dorothy Hodgkin Building
Keele University
ST5 5BG
E: n.leighton@uso.keele.ac.uk
T: 01782 733306

Appendix E -Head teacher consent form – initial instrument trialling

City of
Stoke-on-Trent

DATE

RE: Trialling of Psychological Measures

Dear (insert name),

Firstly, many thanks for expressing an interest in the research project. The form below allows you to provide consent for the research project to take place in your school, I would like to stress that participation is entirely optional. The information below is focussed on how the research will be carried out, the letter which we have previously sent you contains more information regarding the background to the research and why we wish to carry it out. Should you wish to give your consent after reading this letter please complete the consent form at the bottom. If you no longer wish for the research to take place in your school, I would be very grateful if you could let me know.

Should you have any further questions please do not hesitate to contact me directly.

Many thanks,

Nick Garnett

If you are unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Nicola Leighton who is the University's contact for complaints regarding research at the following address:-

Nicola Leighton
Research Governance Officer
Research & Enterprise Services
Dorothy Hodgkin Building
Keele University
ST5 5BG
E: n.leighton@uso.keele.ac.uk
T: 01782 733306

Information and Consent Form – Trialling of Psychological Measures

How many pupils will you require?
As part of this research we are looking for *one* Reception and *one* Year 1 class from your school to take part in this study.

How will you gain consent?
Initially we require your *loco parentis* consent for the project to take place in your school. We would then write to parents via a letter sent home with their children to gain their consent for this to take place. This letter would be of an opt-out format, in that parents should respond to withdraw their consent. Even if parents initially consent to their child participating, they can change their mind at a later point. If they do so, we will ask them to contact the school directly so that you can inform us of their anonymous identifier. We will also give the children an opportunity to decide on the day whether to participate or not and make it clear that they can stop the study at any time without giving a reason and refuse to answer any question. However, most children enjoy the opportunity to give their opinions about their learning. Should you wish to withdraw and individual child or your school please contact Nick Garnett directly.

What will happen during this project?
Researchers from Keele University would come into school and trial the measures with individual pupils at a time which is convenient for your school. Ideally this would take place away from the classroom, or in a quiet corner of it. We would then visit the pupils again after 2 and then 6 weeks to see if their views had changed over time. The trials will take no more than 10 minutes of your pupil's time to complete on each occasion. We intend for there to be minimal disruption to the normal operation of the classroom and would discuss the best way to achieve this with your class teachers. We would ask that the class teacher assigns each pupil a 'code' so that we can follow each child across the 3 time points whilst maintaining their anonymity. It is our intention that there would be minimal input required from your teachers throughout this process.

Who will run the research sessions?
Sessions will be run by researchers from Keele University. All members of the research team have completed a DBS disclosure check and are more than happy to provide you with confirmation of this.

What will happen to this data?
All the data collected will be anonymous and no identifying information will be collected about your pupils or school. This data will be used to ensure that the questions we are asking children are appropriate for their age range. We may publish articles which discuss this research, however your school, pupils and teachers will remain anonymous and only general trends will be reported, no individuals will be identified.

Declaration of Consent

By signing below, you give consent for the research outlined above to take place in your school and that:

- I have been informed about the aims and procedures involved in the research project described above
- I reserve the right to withdraw any child and also to terminate the project altogether if I think it necessary during the data collection period
- I understand that once the data collection is completed, it will only be possible to withdraw either a pupil's or the school's data from the project for *two weeks* after this point
- I understand that the information collected will be anonymous and that pupil's names and the school name will remain anonymous and only general trends will be reported

Name: ____

Signed: ____

School: ____

Date: ____ / ____ / ____

Appendix F - Parental consent letter – initial instrument trialling

City of
Stoke-on-Trent

DATE

Dear Parent/Carer,

My name is Nick Garnett and I am a Postgraduate Research Student working with Dr Yvonne Skipper in the School of Psychology at Keele University. I am excited to inform you that Keele University and Stoke Reads are going to undertake a research project here at **SCHOOL NAME**. The project has been approved by the Keele University Ethical Review Panel and **HEADTEACHER** has also given their consent for the research to take place. Stoke Reads is a programme delivered by Stoke-on-Trent City Council which aims to improve literacy education for younger pupils throughout the city. As part of this larger project our current research aims to encourage children take on more challenging problems in school and to cope better then when they do perform as well as they would like.

What is the aim?
The aim of the current research project is to be able to understand children's views of intelligence and their aspirations. In order to assess what children think about these topics we are developing a short series of questions to examine their thoughts quickly and easily but in a fun way.

What will happen during this project?
We will visit your child's school to trial the series of questions mentioned above. This will take no more than 10 minutes of your child's time and will take place in school. We would like to repeat this 2 and then 6 weeks after we initially visit so that we can see if your child's views have changed over time.

What types of questions will be asked?
We are interested in younger pupil's views on aspiration, intelligence, whether they like to correct mistakes and if they want to develop their skills. We will ask questions such as "What do you want to be when you grow up?" and "You have made a mistake on this drawing but not the other, which one would you like to draw again?" and "Would you like to do hard or easy maths questions?".

What will happen to the information that is collected?
<u>All data collected will be anonymous</u> - each pupil will be given an ID number and we will only record your child's school year and gender; therefore, it will be impossible for them to be identified by name. All the information we gather will only be used to aid the development of the questions. The analysis will only look at trends across the data and therefore it will be impossible for an individual to be identified in any reports about the project.

What do I need to do?

If you choose to give your consent, then no further action is needed. **HEAD TEACHER** has already given their consent for the project to take place in school. Should you wish that your son/daughter not participate for any reason, please complete the slip at the bottom of this letter and return it to school by **DATE**, or alternatively you may contact me directly via e-mail or telephone.

Before we ask your child any questions about their views on intelligence we will tell them that they are optional and ask them if they would like to participate. We often find that children like to express their opinions about their own learning. These questions have been designed to help them do this. If you, or your child does not wish to participate then they will then not complete the initial survey or any follow up surveys.

If this letter is not returned to school by **DATE** then we will assume that you consent for your son/daughter to take part in this exciting project. If, after the above date you wish to withdraw your child from the project you should inform the school directly**.** The researchers will then be provided with your child's anonymous code and their data will be deleted from the project. This will only be possible for *two weeks* after the project has finished in school, therefore after **DATE** we will be unable to remove your child's data. We will write to you after the project has concluded to tell you more about the aims of the study and will remind you about the process for removing data in that letter.

If you require more information, please do not hesitate to contact Nick Garnett at n.j.garnett@keele.ac.uk or on **PROJECT MOBILE TELEPHONE**. Once we have finished we will fully explain the aims of the project to the class as a whole and send home a letter so you too will know more about the study.

Many thanks for taking the time to read this letter.

Kind Regards,

Nick Garnett

FAO: **TEACHER NAME**

I, as parent/guardian do not wish my son/daughter ______________________________

_____ to take part in the Keele University and Stoke Reads views on intelligence project.

Name (Please print): _______________________________________

Signed: _______________________________________

Date: ___________________________________

Appendix G - Final MMYC formatting – instructions, materials, and response sheets

City of
Stoke-on-Trent

Mindset Measure for Young Children
Testing Instructions

Dear Educator,

These measures were designed to allow us to understand how pupils feel about their schoolwork and will ask questions about what they think about intelligence, aspiration and how they feel when they do not perform well on a task. They are designed to take around 5 minutes for each pupil.

Before you begin, please make sure you have these instructions, a blank answer sheet and the testing materials (yes/no, smiley face scale, drawings and easy/hard tasks) with you.

Please use your professional judgement and if a pupil does not seem to be able to understand the question, move on to the next one. To help pupils to concentrate, testing them in a quiet space outside of the classroom is best, but if this is not possible, a quiet corner of the classroom is fine.

Instructions – In these instructions:

- Tick symbols will give you more information about what each section aims to do
- Page numbers (in brackets) refer to pages in the testing materials
- Grey boxes indicate phrases you need to say
- The arrows indicate things you need to do (e.g. note the pupil's answer on the response sheet)
- You will also notice that each section starts with a black box which reminds pupils that there are no right or wrong answers and that this is not a test, please say this before each section.

Response sheet - By every question on the answer sheet there is a box with a question mark in it. Please mark this box if you feel the pupil did not understand the question and leave blank if they understood. Your answer to this will help us to analyse the data better.

Sometimes on the 'smiley face scale', pupils may point to two faces. Please ask them to just choose the one which they think is the best answer and only mark this face on the response sheet, i.e. only circle a single face, not two.

Important - before you begin, please tell the pupil:

"You do not have to answer the following questions if you don't want to. If you want to stop at any point you can and you don't need to give me a reason why."

If a pupil does decide that they don't want to take part, please just write 'withdrew' in the additional information box on their response sheet.

Should a pupil have a literacy level which may prevent them from engaging with the language in these measures then please sensitively excuse them. Please write 'excused' in the additional information box on their response sheet.

Practice responses

Smiley face scale required (Page 3)

✓ Some pupils can struggle to understand how to provide a response when a question asks them to use a scale to rate a feeling or opinion, below are example questions to allow them to practice this.

"I am going to show you some smiley and sad faces, you can use them to show me if you feel happy or sad about something."

- ➔ Place the smiley face scale (Page 3) on the table
- ➔ Point to each face and read each label out loud

"To show you how this works I am going to tell you about how I feel about different flavours of ice cream. I really like chocolate ice cream, so if someone asked me 'How would you feel about eating chocolate ice cream?' I would say 'Really happy'"

- ➔ Point to 'Really happy' and read out loud

"Vanilla ice cream is a flavour that I do not mind, but is not my favourite. If someone asked me 'How do you feel about eating vanilla ice cream?' I would say 'A little sad'"

- ➔ Point to 'A little sad' face and read out loud

"Why don't you have a go? If I gave you some strawberry ice cream now, how would you feel?"

- ➔ Encourage the pupil to point to their response

Questions 1 & 2

~~*Requires smiley face scale (Page 3) and the easy/hard tasks (Page 4)*~~

"Don't forget, this isn't a test and there are no right or wrong

✓ Please point to the easy/hard tasks as you refer to them for each question

Question 1

➔ Place the easy/hard task sheet (Page 4) and the smiley face scale (Page 3) on the table

"Let's say that the things to do in this picture are really easy, you will probably get them all right but you probably won't learn anything new. How would you feel about doing these?"

➔ Record response – mark face chosen

Question 2

"Let's say that the things to do in this picture are really hard, you will probably get some of them wrong, but you will probably learn new things. How would you feel about doing these?"

➔ Record response – mark face chosen

➔ Collect task boards

Questions 3 - 6

Requires both smiley face scale (Page 3) sheet and the picture drawing sheet (Page 5)

✓ Please point to the drawings you refer to for each question

"Don't forget, this isn't a test and there are no right or wrong answers"

- ➔ Place the picture drawing sheet (Page 5) on the table

"Let's pretend that you drew these drawings in class. You made no mistakes when you drew the house, but when you drew the cat you made a mistake and forgot the tail."

Question 3 –

- ➔ Place the smiley face scale (Page 3) on the table

"How do you feel about your drawing of the cat that you got wrong?"

- ➔ Record response – mark face chosen

Question 4 -

"If you got the chance to draw one of these again, how would you feel about drawing the cat that you got wrong last time?"

- ➔ Record response – mark face chosen

Question 5 -

"How do you feel about your drawing of the house that you got right?"

- ➔ Record response – mark face chosen

Question 6 -

"If you got the chance to draw one of these again, how would you feel about drawing the house that you got right last time?"

- ➔ Record response – mark face chosen
- ➔ Collect picture drawing sheet and smiley face scale from pupil

Question 7

No material required

✓ Please record any answer a pupil provides (even if it is 'Lion', 'Fairy' or 'Dragon' etc.).

"Don't forget, this isn't a test and there are no right or wrong answers"

Question 7

"What do you want to be when you grow up?"

- ➔ Record response - as spoken in box on response sheet

Questions 8 - 10

Requires yes/no response sheet

✓ Please do not spend more than 2 minutes with these questions

"Don't forget, this isn't a test and there are no right or wrong answers"

- ➔ Place the yes/no response sheet (Page 2) on the table
- ➔ Point to yes/no whilst reading out loud…

"You can use this to show me if you think Yes or No about something"

Question 8

"Are some people born clever?"

- ➔ Record response – YES/NO

Question 9

"Can they change how clever they are?"

- ➔ Record response – YES/NO

Question 10

"Do you think that you can change how clever you are?"

- ➔ Record response – YES/NO

"Thank you for taking part"

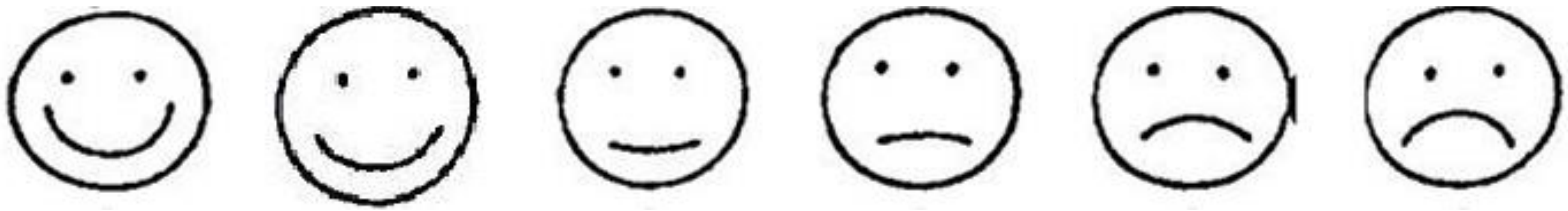
Keele University

City of
Stoke-on-Trent

Stoke Reads Mindset Kit
Testing Materials

✔

NO



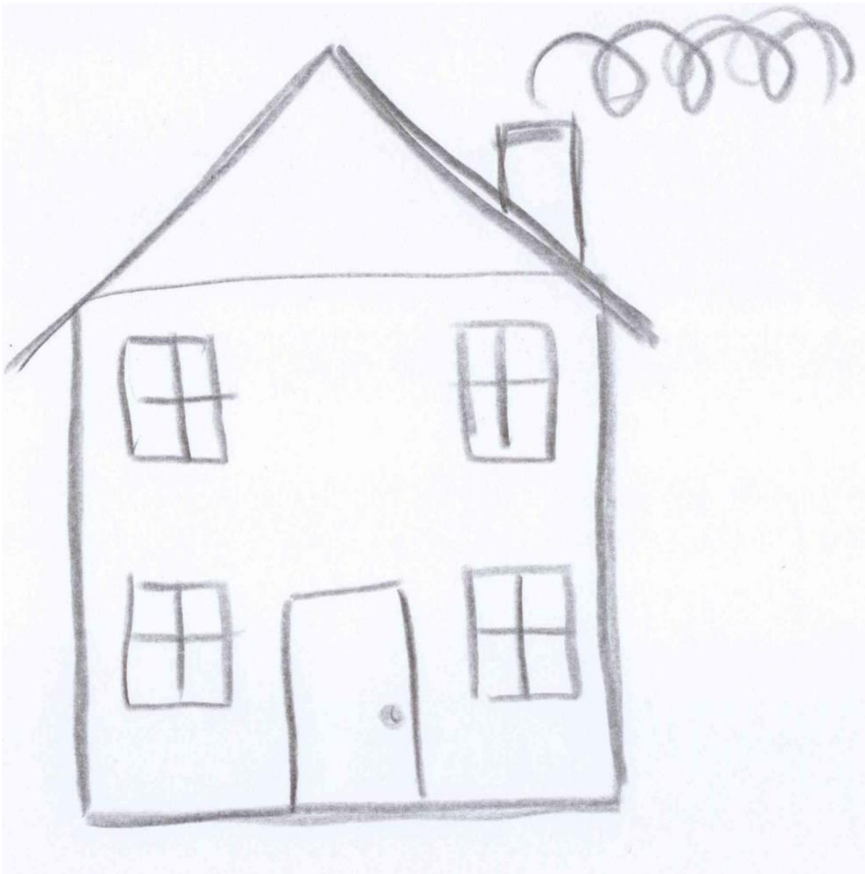
REALLY HAPPY	HAPPY	A LITTLE HAPPY	A LITTLE SAD	SAD	REALLY SAD

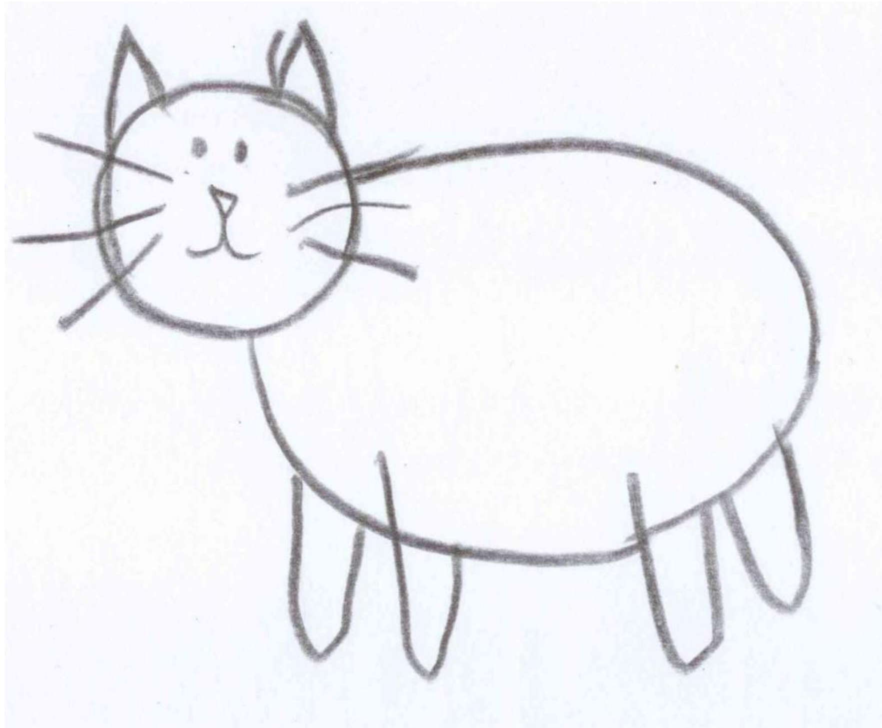
Reptile	?
Disappear	?
Dripped	☑

12 + 5 = 17	☑
20,21…	?
16 − 6 =	?

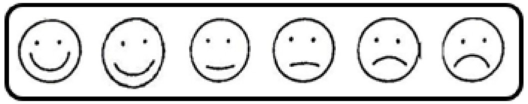
My	☑
Be	☑
So	☑

1 + 1 = 2	☑
1,2,3,4,5	☑
2 − 1 = 1	☑

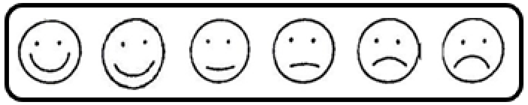




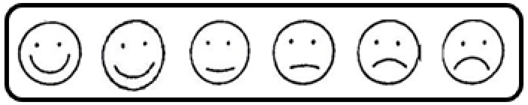
Question 1 – mark chosen face



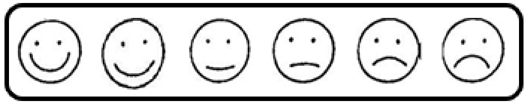
Question 2 – mark chosen face



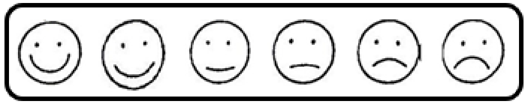
Question 3 – mark chosen face



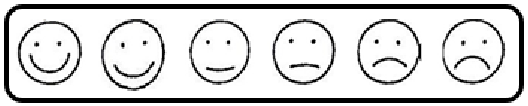
Question 4 – mark chosen face



Question 5 – mark chosen face



Question 6 – mark chosen face



Question 7 – write response in box

Question 8 – Yes or No

Yes No

Question 9 – Yes or No

Yes No

Question 10 – Yes or No

Yes No

Additional Information

Appendix H - Ethical approval - exploration of framework

Keele University

Ref: ERP2348

09/11/2017

Nick Garnett
Faculty of Natural Sciences

Dear Nick

Re: Exploring the structure of growth mindsets (ERP2348)

Thank you for submitting your revised application for review. The proposal was reviewed at the Ethical Review Panel meeting on 19/10/2017. I am pleased to inform you that your application has been approved by the Ethics Review Panel.

If the fieldwork goes beyond the date stated in your application, or there are any amendments to your study you must submit an 'application to amend study' form to the ERP administrator at research.governance@keele.ac.uk stating ERP2348 in the subject line of the e-mail. This form is available via http://www.keele.ac.uk/researchsupport/researchethics/

If you have any queries please do not hesitate to contact me, in writing, via the ERP administrator, at research.governance@keele.ac.uk stating **ERP2348** in the subject line of the e-mail.

Yours sincerely

PP

Dr Colin Rigby

Chair – Ethical Review Panel

CC RI Manager

Appendix I - Information and consent - exploration of framework

Keele University

City of Stoke-on-Trent

Q1.2
INFORMATION ABOUT THIS STUDY
Dear Student,

You have signed up to take part in this survey which aims to increase understanding about how learners view intelligence. This is a joint project between Stoke Reads (part of Stoke City Council) and Keele University. The survey will take approximately 10 to 15 minutes to complete and will ask you questions about your views on intelligence. The survey contains several measures which take different approaches to how they ask about how you view intelligence. There are no right or wrong answers; we are simply interested in your opinions. Any information collected in this survey is anonymous; we will not ask for your name. The data will be held securely by Keele University and no attempts will be made to identify any person who completed the survey.

You do not have to take part in this research if you choose not to. It is not compulsory; if you do not wish to continue please close your browser window now. Once you have begun the survey and answered any of the questions we will be unable to identify your answers and as such it will be impossible to withdraw them. At the end of the survey you will see a “COMPLETION CODE” – you must type the “COMPLETION CODE” into the RPT website in order to receive course credit for completing this questionnaire. If you close your browser window without noting down the completion code, you need to email Nick Garnett (n.j.garnett@keele.ac.uk) ASAP with the time and date you completed the experiment.

If you have any further questions or concerns, please do not hesitate to contact Nick Garnett at: n.j.garnett@keele.ac.uk.

Clicking on the "I understand and agree" button below indicates that:
- You have read the above information
- You voluntarily agree to participate
- You understand that there are no right or wrong answers
- You understand that your responses are completely anonymous
- You understand that after pressing agree your responses can not be removed from the study as they are anonymous

○ I understand and agree (1)

○ I do not understand or do not agree (2)

Appendix J - Debrief - exploration of framework

Firstly, thank you for participating in the study. The main purpose of this study was to explore how behaviours associated with a 'growth mindset' relate to each other. According to Dweck (2000) some people view intelligence as a fixed attribute (fixed mindset) while others view it as something you can develop with effort, like a muscle (growth mindset). There have been various behaviours which have research has suggested form a 'growth mindset', such as:

- Persisting at task following failure (Dweck, Chiu, & Hong, 1995)
- Seeking challenging tasks from which one may learn (Grant & Dweck, 2003)
- A view that intelligence can be developed (Dweck, 2000)

There has been much research which have explored these behaviours and how they influence individuals, and how they relate to a growth mindset. However, this work has explored these behaviours in isolation with limited work which investigates how they all related together to form a growth mindset. We have conducted similar research with 5-year-old children and will compare adult responses to those of children to help us understand how a growth mindset may develop.
Please contact Nick Garnett at n.j.garnett@keele.ac.uk if you have any questions regarding this study.
Thank you again for your participation.

N.B. please do not forget to note down your RPT code which should be entered into the website in order to receive credit for your participation

References

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality and development*. Philadelphia: Psychology Press.

Dweck, C. S., Chiu, C., & Hong, Y. (1995). Implicit Theories and Their Role in Judgments and Reactions: A Word From Two Perspectives. *Psychological Inquiry*, *6*(4), 267–285. http://doi.org/10.1207/s15327965pli0604_1

Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology*. http://doi.org/10.1037/0022-3514.85.3.541

Appendix K - Ethical approval – for co-creation and intervention evaluation

Keele University

Ref: ERP377

6th May 2016

Nick Garnett
School of Psychology
Dorothy Hodgkin Building
Keele University

Dear Nick,

Re: Can a feedback based intervention change children's theory of intelligence and in turn their classroom performance? And, how does a teacher's own theory of intelligence influence their teaching practices?

Thank you for submitting your revised application for review. The Panel would like to thank you for the clarity of your resubmission.

I am pleased to inform you that your application has been approved by the Ethics Review Panel. The following documents have been reviewed and approved by the panel as follows:

Document(s)	Version Number	Date
Overall Project Timeline	1	01-03-2016
Stage 1 Toolkit Co-creation – Teacher Invitation Letter	2	24-03-2016
Stage 2 Head Teacher Letter – Experimental Group	2	24-03-2016
Stage 2 Head Teacher Letter - Comparison Group	2	24-03-2016
Stage 2 Teacher Invitation Letter – Experimental Group	2	24-03-2016
Stage 2 Invitation Letter – Comparison Group	2	24-03-2016
Stage 2 Parent Consent Letter – Experimental Group	1	01-03-2016
Stage 2 Parent Consent Letter – Comparison Group	2	24-03-2016
Stage 2 Teacher Debrief Letter	1	01-03-2016
Stage 2 Parent Debrief – Experimental Group	2	24-03-2016
Stage 2 Parent Debrief Letter – Comparison Group	2	04-04-2016
Stage 2 Online Teacher TOI Measure Information and Consent	1	01-03-2016

Stage 2 Online Teacher TOI Measure Questions	1	01-03-2016
Stage 2 Online Teacher Follow-up Survey Information and Consent Screen	1	01-03-2016
Stage 2 Online Teacher Follow-up Survey Questions	1	01-03-2016

Directorate of Engagement & Partnerships
T: +44(0)1782 734467

Keele University, Staffordshire ST5 5BG, UK
www.keele.ac.uk +44 (0)1782 732000

If the fieldwork goes beyond the date stated in your application (1st October 2017), you must notify the Ethical Review Panel via the ERP administrator at research.erps@keele.ac.uk stating ERP3 in the subject line of the e-mail.

If there are any other amendments to your study you must submit an 'application to amend study' form to the ERP administrator stating ERP3 in the subject line of the e-mail. This form is available via http://www.keele.ac.uk/researchsupport/researchethics/.

If you have any queries, please do not hesitate to contact me via the ERP administrator on research.erps@keele.ac.uk stating ERP3 in the subject line of the e-mail.

Yours sincerely

pp C H Bannerman

Mrs Val Ball
Chair – Ethical Review Panel

CC RI Manager
Supervisor

Appendix L - Information sheet – co-creation for teachers

DATE

Dear (insert name)

My name is Nick Garnett and I am Postgraduate Research Student working with Dr Yvonne Skipper in the School of Psychology at Keele University. We are working with the 'Stoke Reads' programme to investigate the impact of feedback on pupil performance and how a teacher's views of intelligence can influence their classroom decisions.

As you may or may not know, the Stoke Reads group are designing a toolkit, based on previous research, which aims to change how pupils think of intelligence. Our aim is that this toolkit will help pupils to take on more challenging tasks in the classroom, respond more positively when they do not get the results they want and therefore improve their performance. Initially our target age range is Year 1 pupils as we believe it important to give pupils the best possible start in their education.

I am writing to you to ask if you would be willing to help 'co-create' some of the materials that would form the 'toolkit' element of the project. Co-creation, in this context, is when academic researchers work with teachers to design materials which are based on existing theories but also take into account the practical realities of modern classrooms. We are hoping to create:

- A 'handbook' for teachers on how to utilise a particular form of feedback in their classroom
- A series of lesson plans designed to encourage the belief that intelligence can be developed. These will be based around the national curriculum and should integrate into your school's planning
- A series of easy to use psychological measures which will allow teachers to assess their pupils' views on intelligence

I am hoping that you would be interested in assisting in the development of the handbook and lesson plans. The aim is that the toolkit is readily accessible to busy teachers and provides a practical guide for teachers with practical tips to inform practice.

What will this involve for me?

The development of the toolkit will be a collaborative endeavour between various experts from within the Stoke Reads group and Keele University. We would be very grateful for whatever input you would be willing and able to provide. The development period is expected to take a couple of months. How much input you can provide is entirely up to you and is something that we would be delighted to discuss with you further. We may decide to have some face to face meetings, Skype conversations or provide feedback on documents electronically. However, we envision that we will discuss ideas with you and then we will do the 'legwork' and invite you to comment on what we have developed. We also want to stress that we very much appreciate any contribution you feel able to make.

What if I change my mind?

If you do join the project and decide that you need to leave after it has begun, this is not a problem. You are free to withdraw at any point without giving a reason, there is no obligation to participate. Should you decide to no longer be a part of the project then please contact Nick Garnett using the details below. We would be more than happy to provide credit for your contributions towards the project, for example by being named as one of the authors of the manual. However, as this is a group project it would be impossible to remove any one individual's contribution.

What do I need to do now?
If you are interested in participating in this research, please contact Nick Garnett using the details below so we may discuss your involvement further. Participation is entirely voluntary and optional. If you decide that you do not want to be part of the project could I ask that you e-mail me stating as such.

Many thanks for taking the time to read this letter.

Yours sincerely,

Nick Garnett
Postgraduate Research Student
School of Psychology
Dorothy Hodgkin Building
Keele University
ST5 5BG
T: 01782 734402
M: PROJECT MOBILE TELEPHONE
E: n.j.garnett@keele.ac.uk

If you are unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Nicola Leighton who is the University's contact for complaints regarding research at the following address:-

Nicola Leighton
Research Governance Officer
Research & Enterprise Services
Dorothy Hodgkin Building
Keele University
ST5 5BG
E: n.leighton@uso.keele.ac.uk
T: 01782 733306

Appendix M - Stoke Reads Mindset Kit

You can download a copy of the
Stoke Reads Mindset Kit for free at:

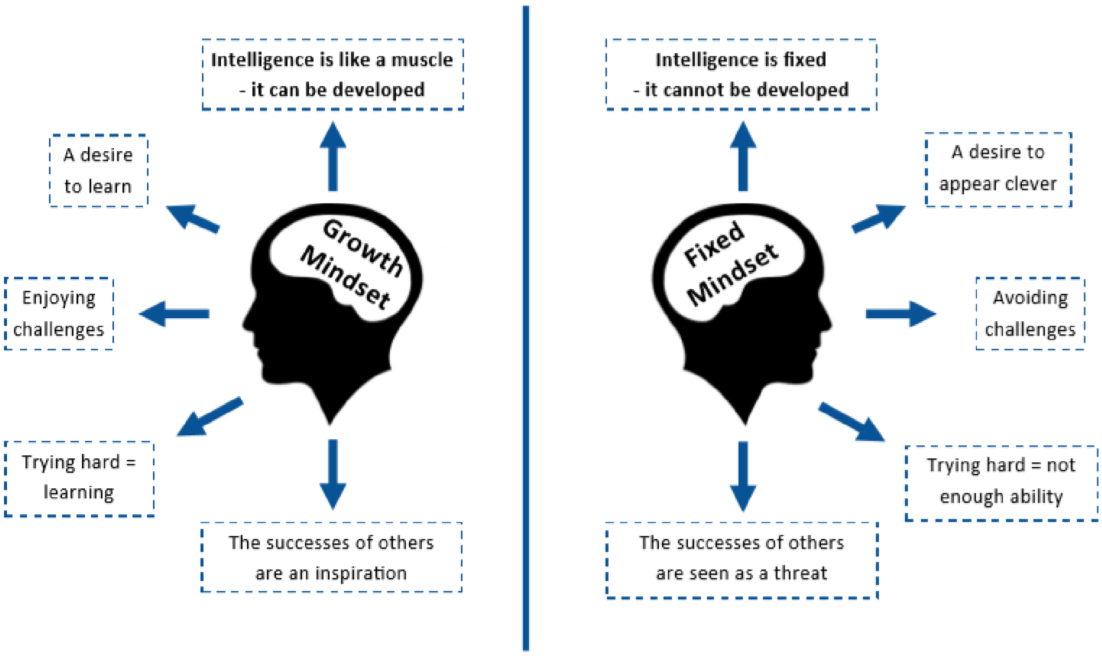
keele.ac.uk/cyp/stokereadsmindsetkit

Contents

Introduction

Dear Educator,

Welcome to the Stoke Reads Mindset Kit. This toolkit has been designed by a group of academics, educational professionals and teachers to provide you with a selection of ideas to promote growth mindsets in your pupils. The idea of mindsets has been researched for over forty years, originally by Professor Carol Dweck and now by many others. This research suggests that we can have either a growth or a fixed mindset and this can affect our beliefs, ideas and behaviours. Different behaviours have been associated with the different mindsets, as shown below...



Impact on learning

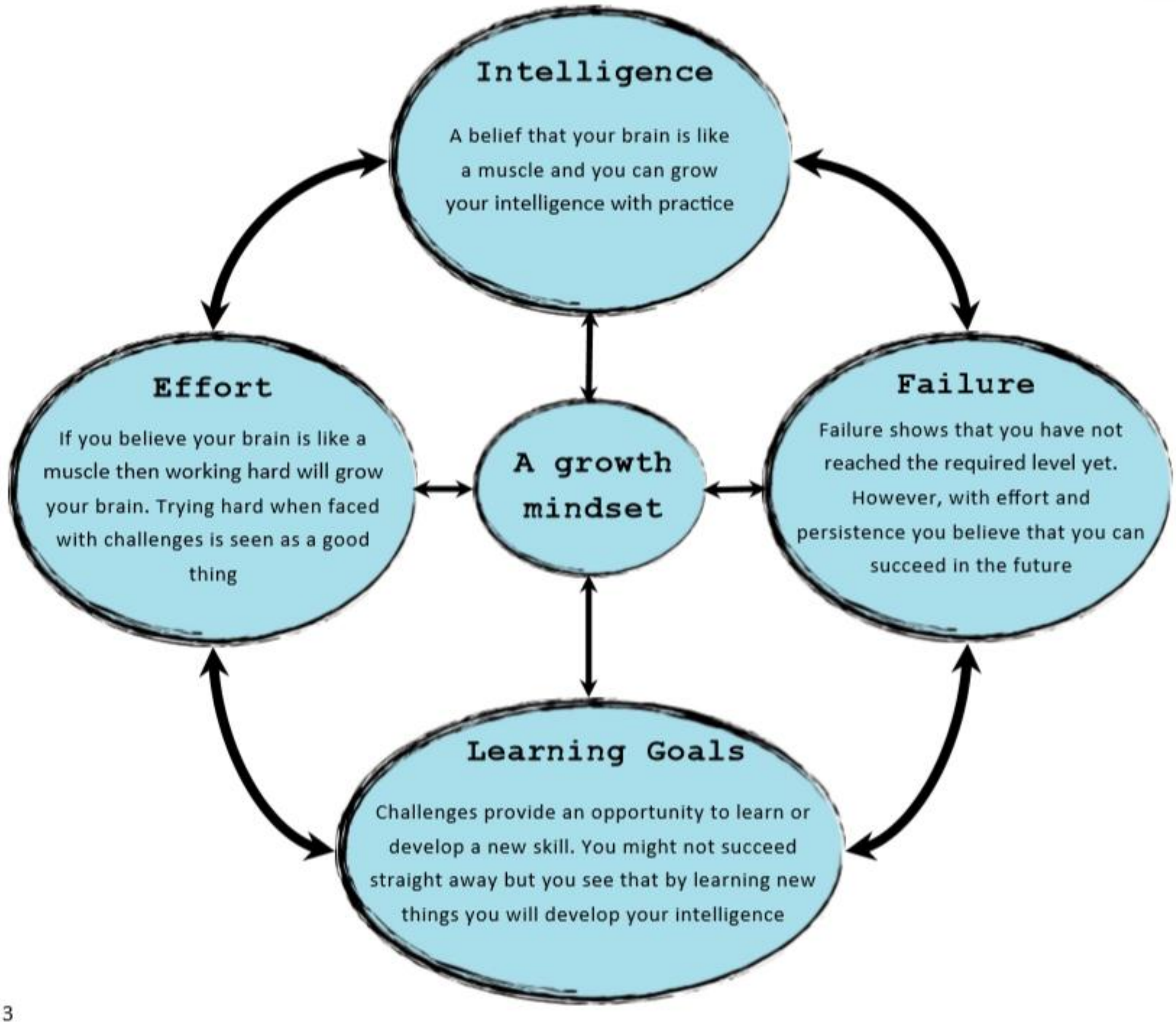
Imagine you give your pupils a choice of two books. They can choose a difficult book with new words which will help them develop their reading, or an easy book which will not develop their reading skills. What could happen?

Some pupils have a fixed mindset; they are likely to choose the easy book. This is because they want to prove that they are a good reader by reading well with ease. This will be possible with the easy book. Should they choose the difficult book, while reading they may make some mistakes. They may have to try hard to understand the words and because of this, they worry that they are not a good reader. To get out of this situation, they say the book is 'boring' and ask to 'go to the toilet'. A pupil with a fixed mindset doesn't believe they can develop their intelligence, so not performing as well as they would like is a sign that they are not clever enough to overcome the challenge.

Other pupils have a growth mindset. They are unlikely to choose the easy book because they don't think they will learn from it; instead they are likely to choose the harder book. Should they appear to be struggling with this challenging book they won't mind, they see the harder book as an opportunity to learn new things. If they struggle with some of the words they are also more likely to keep trying. Performing badly is a sign that they are learning new things and growing their brain. At its heart, a growth mindset is the idea that our brains are like a muscle and that we can develop them with hard work.

Research suggests that mindsets can be changed. Promoting growth mindsets in pupils has been shown to encourage positive behaviours, such as a willingness to take on challenging tasks and persisting following a failure. Growth mindsets mean that regardless of their personal strengths and weaknesses, your pupils will not be limited by their beliefs of what they can and cannot do. Instead they will all be able to achieve their own personal best.

A growth mindset



3

How do I do this?

Various strategies have successfully promoted growth mindsets in pupils. We have taken findings from academic research and worked with teachers to turn these into accessible ideas for your classroom. Even adopting a few of the ideas will help your pupils towards develop a growth mindset. It is important to only adopt ideas which you feel comfortable with and that fit with your classroom. We hope that you feel able to do one activity per half term, but the more you can do, the more you will promote growth mindsets in your pupils. If you come up with any other activities or techniques, then please share them on our Facebook group (Stoke Reads Mindset Kit).

If you only do one thing, make sure that you avoid using person praise which focusses on abilities, i.e. "You are really clever". Instead use process praise which focusses on effort and strategies, i.e. "Well done for keeping going until you got this!". This is explained in much more detail in the *verbal feedback* section.

We believe there is no 'one-size-fits-all' approach to promoting growth mindsets and the most important thing is to be reflective on your own practice and the impact it has had on your classroom. You may notice distinct and rapid changes in your pupils' approaches to learning, or changes may be more subtle. Remember that this is an on-going journey and it is important to maintain growth mindsets over time using ideas from this toolkit or pupils may slip back into old ways of thinking.

Some researchers and teachers have tried to encourage growth mindsets by telling pupils about them and their effects. We wouldn't recommend this because pupils are keen to please their teachers and may tell you they have growth mindsets even when they do not! Also, these ideas can potentially be confusing especially for younger pupils. The more subtle methods we recommend in this toolkit will encourage growth mindsets in your pupils without them realising what is going on!

Verbal feedback

Process praise is a simple way to deliver growth mindset messages to your pupils. We all provide feedback to pupils throughout the day. When pupils get things right we congratulate them and when they get them wrong we try to help them improve. The main idea behind process praise is to praise the process rather than the outcome or the child. When you praise the process you should focus on the effort or strategy used to achieve the end result. This can be used in any subject and can be delivered as written or verbal feedback. For example, you could say:

"Well done for keeping going with these questions. Your concentration was amazing!"

"Your choice of colours in this picture is wonderful."

"You've worked really hard and it really shows because…"

In contrast, person praise focuses more on the pupil and their talents, for example…

"You really have a gift for maths!"

"Such a natural ability for science"

"You are such a great artist"

Process praise helps pupils engage with their learning through the underlying messages it communicates. It focusses on what pupils actually did to achieve the goal. When you reward the *choices* that a pupil made, you are rewarding something which the pupil has control over. Let's reconsider the process praise examples above. The underlined words are the target of the praise, these are all choices. Pupils can choose to work hard or use a particular approach. Praising this promotes a growth mindset as it suggests that the pupil has made a choice which led to their success. They are then more likely to take on challenges and persist following setbacks as their choices can impact their outcomes.

In contrast, think about the underlined words in the person praise examples above. They promote a fixed mindset because they suggest that it is what the pupil is, not what they have done, which has led to success. Pupils who receive this sort of praise may begin to fear not doing as well in the future, because they may no longer be considered to 'have a gift'. They may become focussed on showing they are a 'great artist' rather than developing their skills and they may not take on challenges or persist following a setback.

Should a pupil perform poorly in a task, it is very easy to offer feedback with a degree of 'comfort' associated with it. For example, "Don't worry, not everyone has a maths brain". This suggests to the pupil that the result was due to their 'maths brain' which they have no control over. Although this may seem comforting, it promotes a fixed mindset and suggests that they cannot improve in future. An important part of promoting growth mindsets is being honest about a pupil's progress, suggesting ideas to help them improve and communicating that you believe that improvement is possible.

We all want our pupils to feel positive about themselves; however, please try to avoid using process praise when it is not warranted. We should only praise demonstrations of real effort, serious attempts at multiple approaches to a problem, or genuine achievement.

Also, if pupils are not performing well, you may be tempted to praise their effort as you may find it hard to give them other positive comments. Please try to avoid this if you can. If we give too much process praise it may not have the effect we desire. Pupils may come to view process praise as a 'consolation' for poor performance, or even worse, as something given to children who do not perform well.

Another approach to feedback which can promote growth mindsets is the concept of 'yet'. This is an easy way to turn what might be a potentially negative piece of feedback into a growth mindset message. For example, 'you are not quite there' contains the negative sounding message that the pupil hasn't achieved their potential. It also does not offer any reassurance that they might get there. However, if you add 'yet' onto the end, the feedback becomes a positive, encouraging message to keep going – 'you are not quite there yet'. Importantly, this shows that you believe that they can achieve in the future.

It's everywhere!

Examples of growth mindsets can be found anywhere – don't be afraid to include them in your lessons! You might find them in films, television shows or songs. Below are some examples of films you might have seen, with questions you could discuss with your pupils.

Kung fu Panda:

- Po faces lots of setbacks and isn't very good at Kung Fu when he first starts training with Master SheeFu. What is it that Po does that helps him become great at Kung Fu?

Meet the Robinsons:

- When Lewis shows the Robinsons his machine to make the perfect sandwich and it covers them in peanut butter, why do they celebrate rather than telling him off like he expects?

Princess and the Frog:

- How does Tiana overcome the many challenges she faced and finally get her restaurant?

Music

Music is a great subject to help develop growth mindsets. We would recommend doing this by setting a goal of performing or creating a complex piece of music which will 'stretch' pupils' abilities. Pupils can do this with tuned or non-tuned instruments.

The idea is to demonstrate the progress pupils have made, just like in the *progress display* or *focussed practice* which we cover later in the toolkit. If you have access to some way of recording practice sessions then do this during the first session and again in the final session. You can then listen to these recordings with your pupils, focussing on the progress they have made rather than the quality of the final performance.

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Mindset books

Some great children's books feature growth mindset stories. These can be an excellent way to explore growth mindset ideas, for example, during circle time. We would recommend that you read the book with your class and then discuss the growth mindset message. It is better to avoid 'openly' talking to your pupils about growth and fixed mindsets. Instead, when talking about a book, try to guide the discussion towards the behaviours, thoughts and feelings of the characters which illustrate their mindset. Here are some suggestions for books and questions you can use as a starting point:

The Most Magnificent Thing—Ashley Spires

"Have you ever got mad because you couldn't do something?"

"The girl kept trying, even when she got it wrong. Do you keep trying or give up when you can't do something the first time?"

The Tortoise and the Hare—*traditional*

"Why do you think the tortoise won the race?"
(focus on the fact that he kept trying whilst the hare thought he was so good he didn't need to try)

"Would you keep going if you thought you might not win a race?"

Ish—Peter Reynolds

"Why do you think Raymond doesn't like his drawings?"

"Have you ever given up because you didn't think that you could do something?"

Giraffes Can't Dance—Giles Andreae

"When the lions tell Gerald he can't dance—how does this make Gerald feel?"

"Do you think what the lions said should have stopped Gerald from dancing?"

"Has anyone ever told you that you can't do something? Did you let it stop you like Gerald did?"

The Dot—Peter Reynolds

"What do you think when you can't do something?"

"Have you ever told yourself that you can't do something like Vashti does?"

"Would could you do to get better at things you find tricky?"
(Guide pupils towards the idea that Vashti practised her art)

What Do You Do With an Idea—Kobi Yamada

"Why do you think the child doesn't want to share their idea?"

"What happens if we don't 'take a risk' by sharing ideas or trying new things?"

You can borrow all of these titles from the library service.
Please call **01782 238446** for more information.

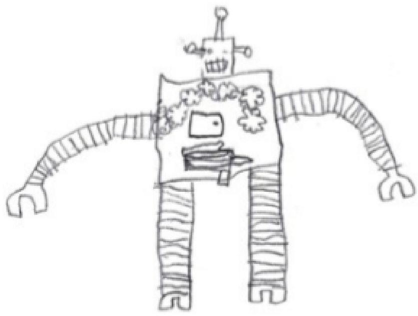
If you find any other titles which have worked for you, please share them on our Facebook group.

Focussed practice

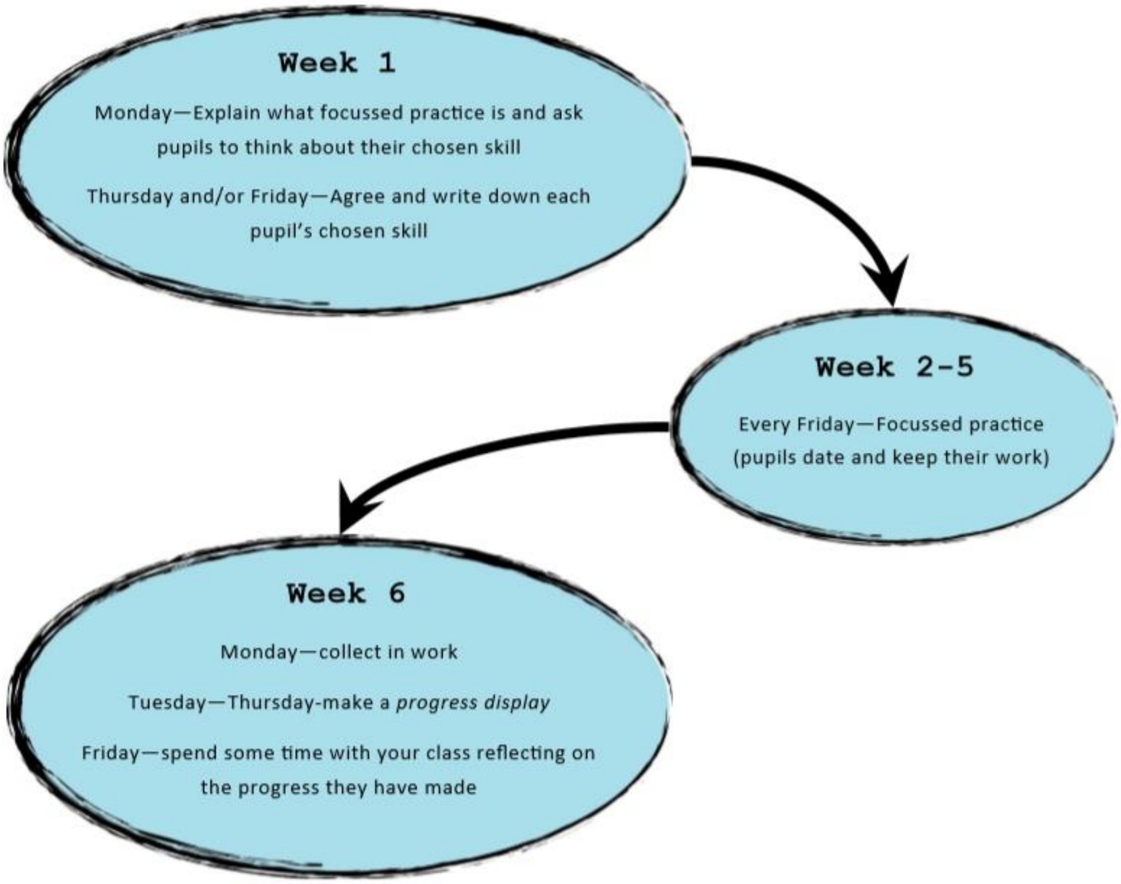
Focussed practice is when pupils work on developing a *specific* skill. This could be a skill which they have chosen and agreed with you, or one that you have set for them. Pupils can be given 5 to 15 minutes on a regular basis to practice this *specific* skill. The key is that pupils date and keep their work. This allows you and your pupil to observe the progress they have made as a result of the focussed practice. You might choose to do this daily or weekly at a time that fits into your class schedule. An example is on the opposite page.

This idea is entirely flexible and can be adapted to your timetable and current topics. Here are some ideas:

- Practicing drawing is a great activity to start with because it can be tied in with any topic. It gives you an opportunity to explore how focussed practice works and drawing allows your pupils to easily see the benefit of regular practice
- If you allow pupils to choose the focus of their practice then they should agree it with you before they begin. It is important that they will develop a particular skill, just practicing 'drawing' is not appropriate, but practicing 'drawing houses' is
- Focussed practice can be used for many skills and subjects, but make sure that the progress which pupils make will be observable. For example, if the topic is times tables then pupils should be able to receive a score. This can be self-marked, peer-marked or marked by you so that pupils can see their scores improving over time
- How often you decide to run a focussed practice is entirely up to you. You can do it at the start of the year, every term or as a constant feature in your class



Focussed practice might look something like this:



Class Dojo

To help you keep track of your classes' growth mindset behaviours, you could use a token reward system such as ClassDojo. It works on most platforms – iOS, android, web browser etc. and it is free! You can find it at www.classdojo.com. There are two types of feedback/tokens you can give: *'positive'* or *'needs work'*. You can customise these categories and set how many points children receive for each behaviour, from -5 to 5. Pupils who display growth mindset behaviours can then be noted and rewarded. In this section, we are going to focus on how to use ClassDojo (or another token rewards system) to promote positive growth mindset behaviours. ClassDojo also includes a series of videos you could use to help introduce growth mindset ideas, these are covered in the *Mindset Videos* section later on.

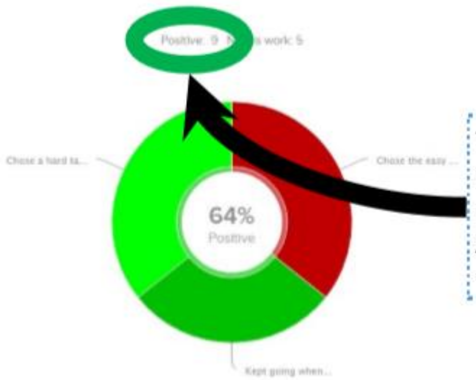
If you decide to use ClassDojo (or another token reward system) you need to plan what you want the rewards to be, e.g. a certificate at 50 points and 'money' to spend in the school shop at 300 points. You may want to decide if, and when points are converted into 'real world' prizes, this could be constantly (i.e. when you reach 50 points) or at particular points (i.e. who has the most points at half-term). Whatever you choose, you do need to make sure this is clear to your class before you begin.

Don't forget that you can either download the app or use a web browser to access ClassDojo. This means you can use it on any device with internet access wherever you are from the playground to a school trip!

Our suggestions for *positive* behaviours:

- On Task +1
- Participating +1
- Working hard +1
- Learnt from a mistake +3
- Kept going when it got hard +2
- Encouraged another +3

ClassDojo allows you to associate *positive* and *needs work* behaviours with points. We recommend that you only use positive reinforcement to promote growth mindsets.



The 'view reports' section of ClassDojo emphasises the percentage in the doughnut graph; this is the amount of feedback pupils have received which is *positive* and *needs work*. We suggest that you use just the *positive* score (in the green circle) as a way of keeping track of points given to reward *positive* behaviours.

You may want to setup your classroom so all your pupils are represented by the same monster avatar at the start of term. You could then allow them to customise their monster as a reward!

Written feedback

Process praise works in both verbal and written feedback and is an easy way to promote growth mindsets. As with verbal process praise, please don't feel like you have to provide it on every piece of work. We have prepared some stickers for you to print out and use, they are available via the website address at the bottom of this page. If you have any suggestions for stickers please get in touch via our Facebook page. Below are some examples...

You found a good way of doing this

You're not quite there yet, but you did a really good job ...

Well done for using your phonics to ...

Well done for taking the time to write your letters clearly

Well done for trying different ways to work out what that word meant

You really thought about how to do the best picture

You were careful and coloured in the lines

Well done, I can see that you have been practising this!

This is much better than last time

I can see a big improvement

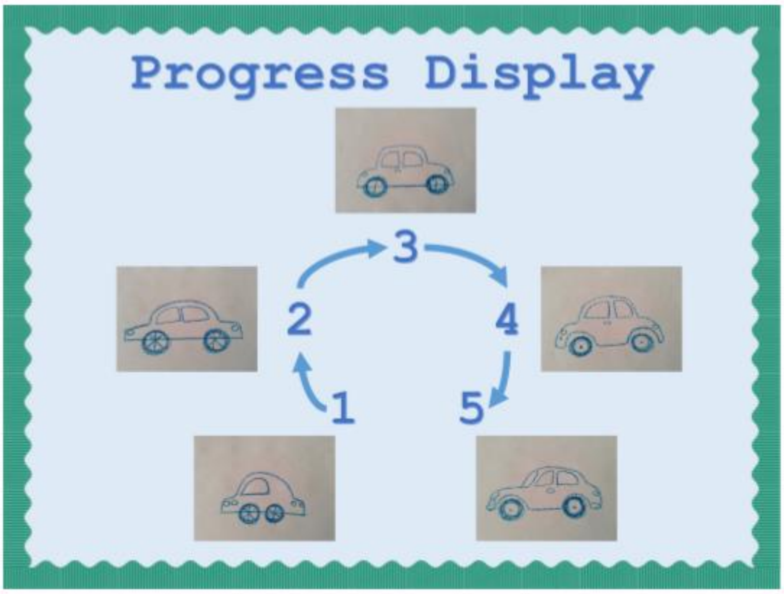
Your practice is paying off!

Our stickers can be found here:

keele.ac.uk/cyp/stokereadsmindsetkit/

Progress display

To encourage pupils to see how effort and practice can help them improve their skills, you can create a display to celebrate progress, rather than a traditional display of 'final' pieces of work. For example, if you decide to use the *focussed practice* idea and one of your pupils showed lots of improvement in their drawings of cars, you might choose to put that on the progress display. We recommend that if you use *focussed practice,* pupils should keep all of their work and reflect on their improvement. These pieces of work can then be part of the progress display to show your whole class how skills develop with practice. It might look something like this…



The *progress display* can be used for more than just art. If you do regular testing with your whole class, you could include these results on the *progress display* too. You might want to order your classes' results by the amount of progress they have made. This will help you emphasise and celebrate their improvement rather than their final mark. You might choose to only display strong examples of progress from individual pupils or examples from every child. This depends on what you feel would work best in your classroom.

Successful people

Many successful people have had a growth mindset. You might be able to talk about their stories, for example in history, science and PE. The main growth mindset message to communicate to pupils is that these 'great' people were not born great and had to work hard to be successful. We are sure you know of some examples which will fit in with your schemes of work for different subject areas, but here a few ideas:

Michael Jordan – "I've failed over and over and over again in my life… that is why I succeed"

Michael Jordan applied to be on his high school basketball team. He didn't make the main team and had to join the junior team. He said he was so disappointed that he cried for a whole week. But he picked himself up and tried harder than ever. He has said that throughout his career whenever he got tired he pictured his high school team list without his name on it and it drove him to keep trying.

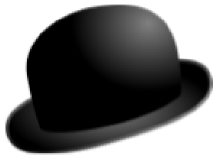
"Do not judge me by my successes, judge me by how many times I fell down and got back up again." - **Nelson Mandela**

Nelson Mandela struggled against many obstacles throughout his life, even going to prison and yet he never gave up on his goal of equal rights for all people.

Thomas Edison – "I didn't fail 10,000 times. The light bulb was an invention with 10,000 steps."

Thomas Edison went to school for only 12 weeks before having to be home schooled for being too 'difficult'. He started a series of small businesses, some of which were not very successful at all. However, he didn't give up and went on to invent over 1,000 different things, one of which was the lightbulb.

Winston Churchill – "Success is the ability to go from one failure to the another with no loss of enthusiasm"



Sir Winston Churchill had many political successes and failures in his career until finally becoming Prime Minister at 62 years old. Many people believe it was his determination which helped him become such a great leader.

J.K. Rowling—"Anything is possible if you've got enough nerve."

The Harry Potter books were rejected by 12 publishers before being accepted. It was J.K. Rowling's persistence and belief that she would succeed which enable the publication of the best-selling book series in history! She once described herself as 'the biggest failure she knew'

"My secret is practice. I have always believed that if you want to achieve anything special in your life you have to work, work and then work some more" - **David Beckham**

David Beckham showed promise as a footballer; at age 11 he won the Bobby Charlton Soccer Schools National Skills Competition. However, he knew that he needed to keep working hard to develop his skills. Even when he was at the top of his game he still practised every day.

Mindset videos

There are some great videos which you could use as a starting point to encourage discussion or just to communicate a growth mindset message. Here are a few suggestions to get started:

On the ClassDojo website, log in and navigate to your class. At the bottom click…

'Big Ideas'

The videos have been designed with discussion questions in mind. They could be a great way get children thinking before having a growth mindset discussion. We recommend trying to watch all of the videos with your class. But, if you only have time for one, 'Mojo puts it all together' would probably be the best.

On YouTube search for :

Sesame Street—Don't Give Up

This is a fun video, featuring a well-known musician and covers persisting with less academic skills such as throwing a ball

Facebook

Please join our Facebook page, a place to share best practice, stories and your experience of using the Stoke Reads Mindset Toolkit…

facebook.com/groups/stokereadsmindsetkit

If you don't use Facebook you can send an e-mail to our group address which will be posted to the group, the group e-mail address is…

stokereadsmindsetkit@groups.facebook.com

The Stoke Reads Mindset Kit was co-created between:

Eloise de Carvalho, Janet Cooper, Lisa Fox, Nick Garnett, Glenys Gill, Dr Julie Hulme, Lizzie Marshall, and Dr Yvonne Skipper

Thanks to Keele University, Stoke Reads and The City of Stoke-on-Trent Council for supporting the project

You found a good way of doing this	You're not quite there yet, but you did a really good job
You were careful and coloured in the lines	Well done for using your phonics to…
Well done for taking the time to write your letters carefully	Well done for trying different ways to work out what that word meant
You really thought about how to do the best picture	Well done, I can see that you have been practicing this!
This is much better than last time	I can see a big improvement
Your practice is paying off	All your practice has helped you get this!
This was really hard, but you kept going!	Let's try something more challenging next time!
You have learnt from your mistakes!	Well done for choosing the hard questions!

Appendix N - Phonics and Early Reading Assessment (PERA)

Appendix O - Information and consent – evaluation for head teachers

DATE

Dear (insert name)

My name is Nick Garnett and I am a Postgraduate Research Student working with Dr Yvonne Skipper in the School of Psychology at Keele University. We are working with the Stoke Reads programme to investigate the impact of feedback on pupil performance and how teacher's views of intelligence can influence their classroom decisions.

As you may or may not know, the Stoke Reads group are designing a toolkit which aims to provide teachers with methods that can be used to change how pupils think of intelligence. These tools are based upon previous research evidence and may help pupils to take on more challenging tasks, respond more positively when they do not get the marks they want and lead to an improvement in their performance in the classroom. We are also interested in how this intervention may influence teachers' views of intelligence and how their views may influence the feedback they provide pupils. Currently the toolkit has been developed for use with Year 1 pupils.

This toolkit is being co-created between the member schools of the Stoke Reads group, partners from Keele University and literacy experts from the Stoke Reads group. The toolkit will provide teachers with:

- A 'handbook' on how to utilise a particular form of feedback in their classroom
- A series of lesson plans designed to encourage the belief that intelligence can be developed. These will be based around the national curriculum and should integrate into your school's planning
- A series of easy to use psychological measures which will allow teachers to assess their pupils' views on intelligence

All of these features are being designed with the time pressures teachers face in mind. They will not be lengthy, complex manuals but offer practical suggestions on how to utilise psychological theory in the classroom. Our aim is to provide a beneficial resource for schools in Stoke-on-Trent with minimal associated cost, or time commitment.

What is required from my school as part of this project?
The Stoke Reads group is hoping to conduct this research across all member schools. Should you choose to participate the commitment would be that:

1. Your Year 1 teachers complete an electronic survey on their views of intelligence at the beginning and end of the school year
    - Time required – less than 10 minutes to complete the survey
    - Taking place – July 2016 and July 2017
2. Your Year 1 teachers deliver a series of pre-planned lessons which are tied to the national curriculum and developed in conjunction with teachers from the Stoke Reads group; these

have an underlying message about promoting a positive view of challenges and how intelligence can be developed
   - Time required – a single lesson slot in the class timetable
   - Taking place – once per half term
3. Your Year 1 teachers complete an electronic survey about their experiences of using the toolkit
   - Time required – less than 10 minutes to complete the survey
   - Taking place – July 2017
4. As part of the Stoke Reads programme, your school is assessing your Reception and Year 1 pupils with the 'Phonics and Early Reading Assessment' forms already. As part of this we would ask teachers to complete a 10-minute set of questions at the same time (to capture your pupil's views on intelligence) which would replace an existing element of the form.
   - Time required – less than 10 minutes per pupil
   - Taking place – alongside the June 2016 and June 2017 PERA assessments
5. You allow a researcher to observe classroom activity at two points throughout the school year (I will contact you separately to arrange this as necessary)
   - Time required – the time required to arrange a date and time
   - Taking place – once between September and December 2016 and once between May and June 2017

What will happen to any data collected?
We may publish articles which could include some or all of the data we collect as part of this project, these reports will only report trends across the whole of the Stoke Reads group and not relate to individual pupils, teachers or schools. We would like to stress that we will not be collecting data which would allow us to identify individual pupils, teachers or schools:

- The data from pupil's taking the 'Phonics and Early Reading Assessment' and questions surrounding intelligence will be anonymised by Stoke-on-Trent Council before being passed to Keele University
- Classroom observations will look at how teachers are providing feedback to pupils and what format these took, no data will be recorded which could identify individual teachers or children

Consent from you
We would need to ask for your *loco parentis* consent for any data surrounding your pupils. You would also need to give your overall consent for the project to take place in your school. You will be able to do this using the consent form below. Should you not wish to be part of the project it would be greatly appreciated if you could contact Nick Garnett using the details below.

Consent from teachers
As we want to ask teachers about their views on intelligence, their experience of using the toolkit and observe the feedback they provide in lessons we will write to them directly to ask consent from them for these elements of the project.

Consent from parents and pupils
Before the research begins we will need to send parents a letter outlining the project to allow them decide whether they wish their children to participate. We would ask that your teachers send two letters home, a week apart, we will provide printed copies of these letters. We will also give the children themselves the opportunity to decide whether to participate and make it clear that they can stop the study at any time without giving a reason and refuse to answer any question. However, most children do enjoy the opportunity to give their opinions about their learning.

If a parent does not wish their child, or a child does not want to be part of the project then we would ask your school to not complete the measures about their views on intelligence as part of the PERA with the pupil. Stoke Reads will also not provide their PERA data to the researchers as part of this project. We will liaise with individual teachers should this occur. We do expect that pupils who are not part of the study may hear the new form of feedback, but we would ask your teacher(s) not to deliver this prescribed form of feedback directly to them if possible. However, as the planned lessons are based upon the national curriculum and have been created in conjunction with experienced teachers we would not ask your staff to provide an alternative activity for a pupil who is not participating in the project.

There may be parents or pupils who wish to withdraw their participation in the project after they have initially granted it. We will instruct parents in letters we send out to contact their child's teacher directly if this is the case. Should this happen we ask that you then contact **STOKE-ON-TRENT COUNCIL (person to be confirmed).** They will then inform Keele University of the pupil's anonymous code and their data will be removed from the project. However, it will only be possible to remove a pupil's data up to three weeks after the final data has been collected (June 2017), this will also be outlined to parents in the letters sent to them.

This letter is in reference to the initial year of the project; this initial year will be from June 2016 to June 2017. However, I may contact you separately regarding any extensions or variation to the project in the future. At the end of the project your school, as part of the Stoke Reads group, will be provided with the toolkit.

I am sure you will have questions about participating in the research and I will phone the school next week to discuss the research in more detail with you. If you require more information, or wish to be in touch sooner, please do not hesitate to contact me (information below).

Many thanks for taking the time to read this letter.

Yours Sincerely,

Nick Garnett
Postgraduate Research Student
School of Psychology
Dorothy Hodgkin Building
Keele University
ST5 5BG
T: 01782 734402
M: PROJECT MOBILE TELEPHONE
E: n.j.garnett@keele.ac.uk

If you are unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Nicola Leighton who is the University's contact for complaints regarding research at the following address:-

Nicola Leighton
Research Governance Officer

Research & Enterprise Services
Dorothy Hodgkin Building
Keele University
ST5 5BG
E: n.leighton@uso.keele.ac.uk
T: 01782 733306

Declaration of Consent
By signing below, you give agree to the following:

- I have been informed about the aims and procedures involved in the research project outlined in the section titled '*What is required from my school as part of this project?'*
- I give my *loco parentis* consent for the pupils in this school to participate in this research project following receipt of permission from their parents
- I reserve the right to withdraw any child and also to terminate the project altogether if I feel it necessary
- I understand that once the project is complete, it will only be possible to withdraw either a pupil's or the school's data from the project for *three weeks* after this point
- I understand that the information collected will be anonymous and that pupil's names and the school name will remain anonymous and only general trends will be reported

Name: ____

Signed: ____

School: ____

Date: ____ / ____ / ____

Please return to:

Nick Garnett

Appendix P - Opt-out consent – evaluation for parents

DATE

Dear Parent/Carer,

My name is Nick Garnett and I am a Postgraduate Research Student working with Dr Yvonne Skipper in the School of Psychology at Keele University. I am excited to inform you that Keele University and Stoke Reads are going to undertake a research project here at **SCHOOL NAME**. Stoke Reads is programme delivered by Stoke-on-Trent City Council which aims to improve literacy education for younger pupils throughout the city.

What is the aim of the project?

This project aims to promote pupil's willingness to take on more challenging problems in school and to cope better then when they do not do as well as they want to. To help us with this we would like to explore your child's views on intelligence at the end of this school year and again at the end of the next school year. Should we find positive results, our findings will be formalised into a toolkit so that many schools across the city will be able to benefit from the potential educational benefits.

What will happen during this project?

Your son/daughter will still enjoy the same education they normally receive; Keele University and Stoke Reads will only be involved 'behind the scenes'. Your child will be asked a short (10 minute) survey in the next few weeks as part of existing literacy assessments which will be taking place in school already. The survey will ask questions about how they think about intelligence, failure and what motivates them to learn. **SCHOOL NAME** will also be providing researchers at Keele University with the literacy assessment results for your child. This will provide us with a picture of what children in the city think about intelligence and learning and if this has had any influence on their literacy levels. At the end of the school year (June 2017) the literacy assessments will be repeated along with the survey about your child's views on intelligence. This will conclude the initial stage of the project.

What types of questions will be asked?

We are interested in younger pupils' views on aspiration, intelligence, whether they like to correct mistakes and if they want to develop their skills. We will ask questions such as "What do you want to be when you grow up?" and "You have made on this drawing but not the other, which one would you like to draw again?" and "Would you like to do the hard or easy maths questions?".

What will happen to the information that is collected?

All data collected will be anonymous; all names and identifying information will be removed by Stoke-on-Trent Council before any data is passed to Keele University. The analysis will look at trends throughout the city and therefore it will be impossible for an individual to be identified in any reports about the project. All the information we gather will be used to help us understand the factors which influence whether pupils take on more challenging problems and cope better when they do not get the grades they want. The project has been approved by the Keele University Ethics Review Panel and **HEADTEACHER** has also given their consent for the research to take place.

What do I need to do?
If you choose to give your consent, then no further action is needed. **HEAD TEACHER** has already given their consent for the project to take place in school. However, should you wish your son/daughter to not participate for any reason please complete the slip at the bottom of this letter and return it to school, or alternatively you may contact me directly via e-mail or telephone by **DATE**.

Before we ask your child any questions about their views on intelligence we will tell them that these questions are optional and ask them if they would like to participate. If you, or your child does not wish to participate then they will then not complete the initial survey or any follow up surveys. Your child's school will also not provide any of the literacy assessment data to the researchers for this project.

If this letter is not returned to school by **DATE** then we will assume that you consent for your son/daughter to take part in this exciting project. Should you wish your son/daughter not to be a part of the project after this date or if you wish to withdraw your child's responses from the research then please contact your child's teacher directly. If this is the case at the end of Year 1 (June 2017) when we complete the project, then we will only able to do this 3 weeks after the final survey has taken place. We will however be writing to you about the project after the final survey has taken place, to give you more information about the research. This letter will also include information about how to withdraw your child's data.

Once we have finished the project we will fully explain the aims to the pupils and will also send home a letter so that you too can learn more about what was found. If you require more information, please do not hesitate to contact me using the details below.

Many thanks for taking the time to read this letter.

Kind Regards,

Nick Garnett
Postgraduate Research Student
School of Psychology
Dorothy Hodgkin Building
Keele University
ST5 5BG
E-mail: n.j.garnett@keele.ac.uk
Telephone: PROJECT MOBILE NUMBER

FAO: **TEACHER NAME**

I, as parent/guardian, do not wish my son/daughter ____ to take part in the Keele University and Stoke Reads attitudes to learning project.

Signed: __________________________________

Name: __________________________________

Date: ______ / ______ / ______

Appendix Q - Information and consent – evaluation for teachers

DATE

Dear (insert name)

My name is Nick Garnett and I am Postgraduate Research Student working with Dr Yvonne Skipper in the School of Psychology at Keele University. We are working with the 'Stoke Reads' programme to investigate the impact of feedback on pupil performance and how teacher's views of intelligence can influence their classroom decisions.

As you may or may not know, the Stoke Reads group are designing a toolkit which aims to provide teachers with tools that can be used to how pupils think of intelligence. This toolkit is based on previous research and may help pupils to take on more challenging tasks, respond more positively when they do not get the results they want and therefore improve pupil performance. Initially our target age range is Year 1 pupils as we believe it important to give pupils the best possible start in their education.

This toolkit is being co-created between the member schools of the Stoke Reads group, academics from Keele University and literacy experts from the Stoke Reads/Stoke Speaks Out group. It will provide teachers with an introduction to the theory behind the intervention, a series of pre-planned lessons (based around the national curriculum) which aim to encourage the belief that intelligence can be developed and psychological measures which will allow teachers to assess their younger pupil's views on intelligence.

I am writing to you today to inform you that we have already contacted **HEAD TEACHER'S NAME** and they have given their permission for the development of this toolkit to take place in your school.

What will this involve for me?
We are very much aware of the pressures which teachers can face. Therefore, this project has been designed to require minimal time commitment from you and provide you with potentially beneficial materials at the end of it.

We would ask that:

1. As part of the Stoke Reads programme your school are already completing the 'PERA' assessments with Reception and Year 1 children. We ask that instead of completing the motivation and attitude measures that are on the second side of the forms that you complete

our new questions designed to measure how children view intelligence.
    - Time required – less than 10 minutes per pupil
    - Taking place – alongside the June 2016 and June 2017 PERA assessments
2. You endeavour to use a particular form of feedback throughout your normal day-to-day teaching practice, from September 2016 until June 2017 as outlined in a guidebook we will provide to you as part of the toolkit
    - Time required – about 20 minutes to read the guidebook
    - Taking place – before the beginning of the 2016/17 academic year
3. You complete an online survey about your own views surrounding intelligence at the beginning and end of the project
    - Time required – less than 10 minutes to complete the survey
    - Taking place – July 2016 and July 2017
4. You complete a short online survey at the end of the project about your experiences and views of using the toolkit
    - Time required – less than 10 minutes to complete the survey
    - Taking place – July 2017
5. You endeavour to deliver a series of pre-planned lessons which are tied to the national curriculum and developed in conjunction with teachers from the Stoke Reads group; these have an underlying message about promoting a positive view of challenges and how intelligence can be developed
    - Time required – a single lesson slot in your class timetable
    - Taking place – once per half term
6. We also ask that you allow a researcher to visit your school and observe your teaching for an hour and we will contact you separately to arrange this as necessary
    - Time required – the time required to arrange a date and time
    - Taking place – once between September and December 2016 and once between May and June 2017

Consent from parents and pupils

Before the research begins we will need to send parents a letter outlining the project so they may decide whether they wish their child(ren) to participate. We would ask that you send two letters home, a week apart; we will print these for you. We will also give your pupils the opportunity to decide whether to participate or not and make it clear that they can stop the study at any time without giving a reason and refuse to answer any question. However, most children do enjoy the opportunity to give their opinions about their learning.

If a parent does not wish their child, or a child does not want to be part of the project then we would ask you not to complete the measures about their views on intelligence as part of the PERA assessment with the pupil. Stoke Reads will also not provide their PERA data to the researchers for this project. We do expect that they may be exposed to this different form of feedback, but we would ask you not to deliver this prescribed form of feedback directly to them if possible. However, as the planned lessons are based upon the national curriculum and have been created in conjunction with experienced teachers we would not ask you to provide an alternative activity for a pupil who is not participating in the project.

There may be parents or pupils who wish to withdraw their participation in the project after they have initially granted it. We will instruct parents in letters we send out to contact you directly if this is the case. Should this happen we ask that you then contact **STOKE-ON-TRENT COUNCIL (person to be confirmed).** They will then inform Keele University of the pupil's anonymous code and their data will be removed from the project. However, it will only be possible to remove a pupil's data up to three weeks after the final data has been collected (June 2017), this will also be outlined to parents in any letters sent to them.

What happens to any data that is collected?
All data collected will be anonymised; it will be impossible to trace you, your pupils and your school in the data. Reports of findings will be looking at trends within the group not specific individuals or schools. At the end of the project your school will be provided with the toolkit.

Do I have to participate?
No, participation is entirely voluntary and you are free to withdraw from any element of the study at any point. For example, if you decide that you do not wish to participate in the online questionnaire about your views of intelligence at the end of the year you can withdraw from just that element of the project. To withdraw from any element please contact Nick Garnett using the information provided below.

What do I need to do now?
If you have any questions, please do not hesitate to contact me using the details below. If you would like to be a part of this project, please complete the consent form at the bottom of this letter. You also do not have to take part in all elements of the project if you do not wish to do so. If you do not wish to be a part of this project it would be greatly appreciated if you could let me know using the details below.

Many thanks for taking the time to read this letter,

Yours sincerely,

Nick Garnett
Postgraduate Research Student
School of Psychology
Dorothy Hodgkin Building
Keele University
ST5 5BG
T: 01782 734402
E: n.j.garnett@keele.ac.uk

If you are unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Nicola Leighton who is the University's contact for complaints regarding research at the following address:-

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Research Governance Officer
Research & Enterprise Services
Dorothy Hodgkin Building
Keele University

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E: n.leighton@uso.keele.ac.uk
T: 01782 733306

Declaration of Consent
By signing below, you agree to the following:

- I have been informed about the aims and procedures involved in the research project outlined in the section titled '*What will this involve for me?*' and consent to be a part of the following (please initial in the boxes to indicate consent for each element):

☐ 1 – completing measures alongside the PERA assessments

☐ 2 – endeavouring to use a specific style of verbal praise in my day to day practice

☐ 3 – completing an electronic survey on my views surrounding intelligence in July 2016 and July 2017

☐ 4 – completing an electronic survey about my experience of using the toolkit in July 2017

☐ 5 – endeavouring to use a series of pre-planned lessons once per half-term

☐ 6 – having the feedback I deliver in class observed by a researcher on two occasions over the school year

Name: ____

Signed: ____

School: ____

Date: ____ / ____ / ____

Please return to:

Nick Garnett