UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL, HUMAN AND MATHEMATICAL SCIENCES

School of Psychology

An investigation into the associations between maths anxiety in secondary school pupils and teachers' and parents' implicit theories of intelligence and failure

by

Anna Clara Rindeline Doedens-Plant

Thesis for the degree of Doctor of Educational Psychology

June 2018

Total Word Count: 17,657 words

Systematic Literature Review: 9,742 words

Empirical Paper: 7,915 words

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ABSTRACT

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AN INVESTIGATION INTO THE ASSOCIATIONS BETWEEN MATHS ANXIETY IN SECONDARY SCHOOL PUPILS AND TEACHERS' AND PARENTS' IMPLICIT THEORIES OF INTELLIGENCE AND FAILURE

Anna Clara Rindeline Doedens-Plant

This research examined the role that teachers' mindsets, or implicit beliefs about intelligence and failure, play in the development of their pupils' mindsets and subsequent maths anxiety. A systematic review of fourteen studies investigated the association between teachers' implicit beliefs about intelligence and their pedagogical practices in the classroom. It showed that teachers tended to report having a growth mindset, but this was not necessarily evidenced by concordant classroom practice, such as the adoption of mastery goals. Fixed mindset beliefs, on the other hand, seemed to lead to more consistent practice, with potentially damaging effects. The empirical study built on this review to explore mindset (i.e., implicit beliefs about intelligence and failure) in secondary school pupils in Years 7, 8 and 9 (N=859), their parents (N=84) and teachers (N=9). Pupils were also asked about their perceptions of their parents' and teachers' goals, as either oriented towards performance or learning. The results pointed to several factors associated with pupils' maths anxiety (i.e. gender, maths set). Also, pupils' implicit beliefs that failure is debilitating were associated with pupils' maths anxiety. Teachers' implicit failure beliefs were associated with pupils' beliefs about failure and were indirectly linked via pupils' perceptions of their teachers' goals as fixed. Further analysis highlighted that pupils' intelligence beliefs, their perception of their parents' goals and their maths set also impacted on whether or not pupils' viewed failure as debilitating or beneficial for learning. These results suggest that teachers can make a useful contribution to reducing pupils' maths anxiety, by reflecting on how to translate helpful beliefs into visible practice, to help pupils experience failure as an opportunity for learning.

Table of Contents

Table of Tables

Table of Figures

Academic Thesis: Declaration of Authorship

I, Anna Clara Rindeline Doedens-Plant, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

An investigation into the associations between maths anxiety in secondary school pupils and teachers' and parents' implicit theories of intelligence and failure

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signed: .....

Date: .....

Acknowledgements

This written work is the end of a very long journey, which started even before I embarked on the doctoral training. Many people have accompanied me on my way and have made unique contributions, which have helped me to get this far.

First of all, I would like to thank my supervisors, Dr Julie Hadwin, Dr Sarah Wright and Dr Tim Cooke for their support and advice. I have valued all the opportunities you have given me to discuss ideas and I have appreciated all the feedback you have given as this project took shape. I would also like to thank Polly Langdon and Dr Claire Hart for additional advice.

I would like to thank the whole of the course team of the Doctoral Training programme. Your teaching, advice, administrative support and friendly chats have enriched my experience over these last three years, more than you can maybe imagine.

I would like to thank the head teacher of the participating school for his enthusiasm for my project and the practical support in carrying it out. I would also like to thank all the pupils, who participated in overwhelming numbers, as well as the parents and teachers who took the time to take part.

I am grateful to my uncle and aunt, Piet and Greetje, for welcoming us in their home and heart when the world had changed. You helped me to find some solid ground again, which made it possible for me to finish this year.

I am especially indebted to my husband Tim and my children Vincent and Tessa for their endless love and support. This training has been a team effort: without the three of you I could not have arrived at this point. Many cups of tea and snacks at my desk, as well as encouraging words when I needed it, have carried me through. I love you all.

Finally, I would like to dedicate this thesis to my dad Klaas, who would have been very proud, and to my mum Matty, whose lifelong example of tenacity and grit has given me the courage to carry on, even now I miss her so dearly.

Definitions and Abbreviations

ANOVA	Analysis of variance
α	Cronbach's alpha reliability statistic
β	Standardised regression coefficient
B	Unstandardised regression coefficient
d	Cohen's d, measure of effect size
ΔR^2	Change in R^2
F	*F*-ratio, test statistic used in ANOVA
η^2_p	Partial eta-squared
ICC	Intraclass correlation
M	Mean
N	Total sample size
n	Size of a group of participants
p	Probability value
r	Pearson's correlation coefficient
R^2	The coefficient of determination, or proportion of data explained
SD	Standard deviation
SE B	Standardised error of beta value
t	Test statistic for independent t-test
χ^2	Chi-square statistic

Chapter 1 Teachers' mindsets and their influence on pedagogical practices in the classroom; a systematic review

1.1 Introduction

The concept of intelligence is widely disputed and no single definition exists. Some theorists, for example, have argued that intelligence can be captured by one single factor (Spearman, 1946; Terman et al., 1915), whereas others have argued that it is made up of multiple factors (Gardner, 2006; Horn & Cattell, 1966; Sternberg, Castejón, Prieto, Hautamäki, & Grigorenko, 2001; Thurstone, 1936). Theories such as these are explicit, clearly defined reflections both on what intelligence means and what its components are. However, Kelly (1963) proposed that outside the field of science, people also hold theories that they use to try to predict and control their world. This includes ideas about intelligence, which, in contrast with scientific theories, are not consciously expressed or considered, but which nevertheless underpin how we create meaning in a complex social world (Plaks, Levy, & Dweck, 2009) These have been defined as implicit theories of intelligence (Dweck & Leggett, 1988).

1.1.1 Implicit theories of intelligence

Dweck and Leggett (1988) proposed that attributions of success and failure are made within the constructs of two distinct implicit theories of intelligence. This proposition was based on earlier research by Dweck and Reppucci (1973), which highlighted that, when faced with challenge, some children displayed helpless behaviours; they started to think negatively about their own ability, to feel bad about themselves and to talk about things that were irrelevant to the task. Other children remained mastery oriented; during failure, as well as success, trials, they persisted in looking for solutions and they continued to self-monitor and self-instruct. These different patterns of response resulted in different performances, although there was no difference between the groups in their initial ability to solve the task, only the helpless group showed a decrease in performance (Dweck & Reppucci, 1973). In later research by Diener and Dweck (1978), children from

both helpless and mastery-oriented groups were asked why they thought they struggled with a particular difficult task. More than half of the children from the helpless group responded to this with ability attributions, which meant that they ascribed their failures to a personal lack of ability, which none from the persistent group did. Mastery-oriented children also made significantly more effort attributions; they explained their lack of success more often to lack of effort. Also, helpless children expressed more negative emotions and engaged more frequently in task irrelevant verbalisations (Diener & Dweck, 1978).

This research led Dweck and Leggett (1988) to hypothesise that children in the helpless group were pursuing performance goals, or goals to prove their ability, based on an entity theory of intelligence. This is the belief that intelligence is a fixed trait that cannot be changed over a lifetime; this belief is often referred to, in later literature, as a fixed mindset (Haimovitz & Dweck, 2017). Dweck and Leggett (1988) reasoned that children in the mastery-oriented group, on the other hand, were pursuing learning goals with which they tried to improve, rather than to prove, their ability. According to Dweck and Leggett, the children based these learning goals on an incremental theory of intelligence, which is the belief that intelligence is malleable and can be increased, and which is often referred to as a growth mindset (Haimovitz & Dweck, 2017). As these opposing implicit theories, or mindsets, seemed to be associated with increased use of distinct behavioural patterns, they became the topic of much scrutiny in the realm of educational research, as well as other achievement domains (see, for example, Burnette, O'Boyle, VanEpps, Pollack & Finkel, 2013).

1.1.2 Why mindsets matter

Some studies have found implicit theories of intelligence, or mindsets, to be predictive of academic achievement in different populations. Blackwell, Trzesniewski and Dweck (2007), for example, found in a longitudinal study with adolescents that implicit theories of intelligence, measured at the beginning of seventh grade (equivalent to Year 8 in the United Kingdom), were predictive of a diverging growth path in maths achievement. The pupils holding incremental beliefs achieved significantly higher maths test scores at the end of the following academic year. Others have argued that the relationship between mindset and academic achievement is bidirectional (Park, Gunderson, Tsukayama, Levine, & Beilock, 2016). A recent meta-analysis, which included 129 studies, found heterogeneous results in terms of the relationship between mindsets and academic achievement. Where some studies found a positive association between

incremental beliefs and academic achievement, with medium to large effect sizes, others found no significant effect at all. Some studies found even opposite effects, in which having a growth mindset appeared associated with lower academic achievement. The result overall was a weak association between mindset and academic achievement (Sisk, 2017). Further research is therefore warranted to explore the reasons behind this high level of heterogeneity in more detail.

Apart from academic achievement, the effects of mindsets have also been investigated in relation to academic emotions and behaviours. King, McInerney and Watkins (2012) found that having an fixed mindset was a large contributor to negative emotions in school, such as anger, anxiety, shame, boredom and hopelessness. This was true even after other factors, such as gender, year group, parental and teacher support, as well as goal setting, had been taken into account. Although this was a large sample of secondary school pupils, the study took place in the Philippines, so further replication would be required to investigate if the same associations would be found in a European context. A fixed mindset has also been found to be associated with self-handicapping behaviours, such as putting off school work until the last minute (Rickert, Meras, & Witkow, 2014; Shih, 2011). Mindsets have attracted the attention of many researchers, but they have also become salient in educational practice; most teachers have become very familiar with the concept of growth mindset and many of them will have quoted it to their pupils (Bloom, 2017).

1.1.3 How mindsets develop

Although the association between mindsets on the one hand, and academic achievement, emotion and behaviour on the other hand, still warrants further scrutiny, the literature suggests that they may play a distinctive role. This then leads to the question of how mindsets develop. Intuitively, it seems plausible that children adopt a mindset as a result of those of the adults around them. Nonetheless, Haimovitz and Dweck (2016) found no direct correlation between parents' intelligence mindsets and their children's mindsets. Parents' mindsets did not appear visible for children, at least children were not able to report accurately on their parents' beliefs about intelligence. In contrast, they were able to perceive that their parents believed failure to be either debilitating or beneficial to learning. As a part of this study, parents were given a vignette to read, in which their child was reported to come home after having failed a test. Parents who believed that failure was debilitating were more likely to react to this vignette

with concern about performance and lack of ability. It was also these parents who tended to have children with fixed mindsets. This suggests that adults' behaviours, rather than their beliefs and, more specifically, adults' responses to success and failure, are influential for children's mindsets.

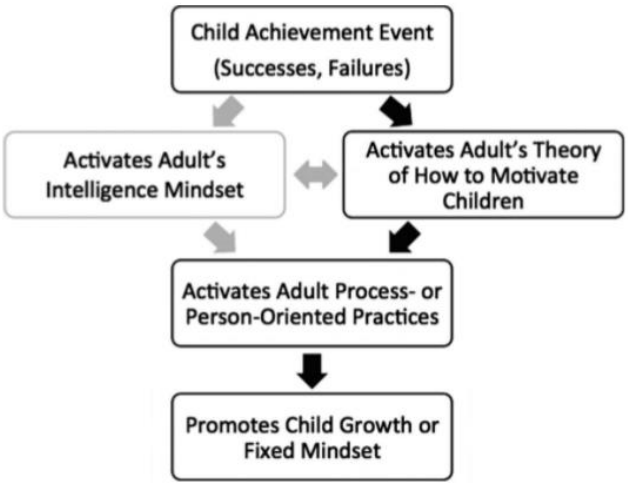
When children experience success, a common response is to give them praise. However, research has suggested that not all types of praise have the same impact on children. Mueller and Dweck (1998) found in an experimental study that children who were praised for intelligence in a first task (such as "you must be smart at these problems") were significantly more likely to attribute a subsequent failure to lack of ability. They were also less likely to show task persistence and task enjoyment. Interestingly, the results of this study showed that praise for effort (such as "you must have worked hard at these problems") did not lead children to make effort attributions after they failed a task, in comparison with a control group who received no additional feedback. Praise for effort did not lead to higher post-failure task persistence compared to the control group, either. It seems therefore that entity beliefs were particularly detrimental, rather than incremental beliefs being beneficial. Pomerantz and Kempner (2013) found a similar effect in a longitudinal study of mothers' praise of their primary school-aged children. Mothers' person-related praise was predictive of their children's fixed mindset and aversion to challenge, but their process-related praise did not diminish their children's fixed mindset nor did it increase their preference for challenge.

1.1.4 Intelligence mindsets in a school context

Teachers play an important role in the lives of children at school and arguably one might expect that they therefore have a significant influence on children's mindsets. Contrary to this prediction, Park, Gunderson, Tsukayama, Levine and Beilock (2016) found no direct association between the mindsets of teachers and children in the first and second grade (equivalent to Years 2 and 3 in the United Kingdom), which echoes the findings of Haimovitz and Dweck (2016) on parental and children's mindsets. Instead, children's fixed mindsets were predicted by their teachers' performance goals. In contrast, children's growth mindsets were not found to be predicted by their teachers' mastery-oriented goals. This shows similarities to the studies by Pomerantz and Kempner (2013) and (Mueller and Dweck1998), as fixed mindsets were predicted by adults' actions, whereas growth mindsets were not.

Haimovitz and Dweck (2017) proposed that adults' intelligence mindsets may sometimes, but not always, be activated when they respond to children's successes and failures. They presented a model in which adults' process- or person-oriented practices are informed by both their intelligence mindset and by their theory of how to motivate children. They hypothesised adults' intelligence theories and motivation theories to be bi-directionally influential (see Figure 1).

Figure 1. Hypothesised model of how adults socialise children's growth and fixed mindsets



(Haimovitz & Dweck, 2017, reproduced with permission from K. Haimovitz)

This review takes this model as a starting point and investigates the relationship between adults' intelligence mindsets and their process- or person-oriented practices. More specifically, it looks at the intelligence mindsets of teachers and their pedagogical practices in the classroom. It sets out to answer the following two questions:

1. What do we know about the implicit theories of intelligence held by teachers?
2. How do these theories influence their pedagogical practices in the classroom?

1.2 Review Methodology

1.2.1 Search Strategy

To answer the two questions outlined above, a research protocol was developed (see Appendix A), which was shared with supervisors, and a systematic search

was conducted using four electronic databases: PsycINFO and PsycARTICLES via EBSCO; the Educational Research Information Centre (ERIC); and Web of Science via Web of Knowledge. No limiters were applied. The last search was carried out in December 2017. Key words for the search were generated using the key words and related synonyms from the title of the review, as well as using the key words from research papers on implicit theories of intelligence (see Appendix A).

1.2.2 Inclusion and Exclusion Criteria

All articles resulting from the initial search were screened according to the inclusion and exclusion criteria detailed in Table 1 and were included in the review if they fulfilled the inclusion criteria.

Table 1. Inclusion and Exclusion criteria used for systematic review

Study characteristic	Inclusion Criteria	Exclusion Criteria
Theoretical concept	Implicit theory of intelligence	Other implicit theories or attribution frameworks
Focus	Teacher mindset	Student mindset
Measurement	Includes a measure of mindset	Does not include a measure of mindset, only theoretical discussion
Publication requirements	Written in English	Written in a language other than English
	Written after 1988	Written before 1988
	Written in peer-reviewed journal	Not peer-reviewed

1.2.3 Quality Assessment and Data Extraction

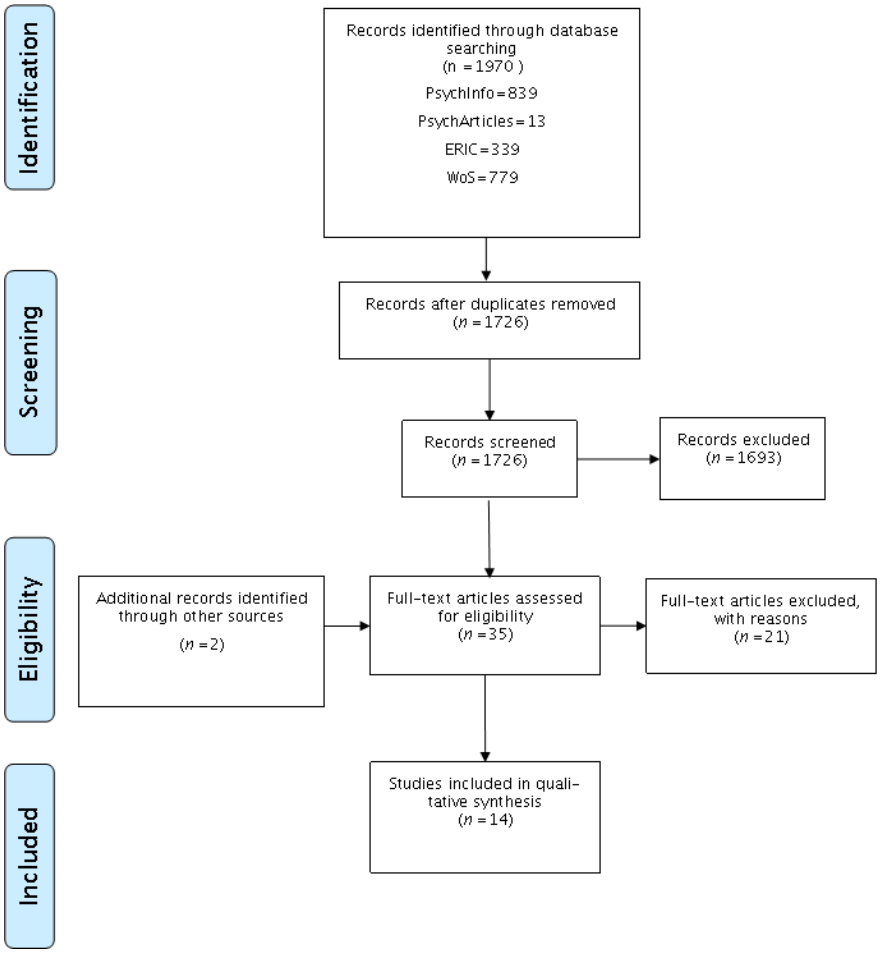
Studies that met the inclusion criteria were assessed for methodological quality, meaning the quality of reporting, as well as external and internal validity, by using an adapted version of the quality assessment checklist developed by Downs and Black (1998). Based on the criteria set by O'Connor et al. (2015), the quality of articles was considered high where scores were 11 or above, medium with scores from eight to ten and low with a score of seven or below. The assessment of methodological quality and weight of evidence of all included articles can be found in Appendix B. Also, each study was rated in terms of methodological appropriateness and specific focus in light of the review question, after which a

score for overall weight of evidence was established, which can be found in Appendix C (Gough, 2007). Data that was relevant to the review question was extracted from the included texts by the researcher (see Appendix D); other information included in the text, such as results from additional studies within the journal articles, was omitted. The extracted data was used for a narrative synthesis of the research.

1.3 Systematic Review Results

The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The search described above, using the key terms detailed in Appendix A, resulted in the retrieval of 1726 articles, after duplicates had been removed. Titles and abstracts of these were screened for relevance. Thirty-three of these were retrieved in full text. Twenty-one articles were subsequently excluded; details of these, as well as the reasons for exclusion, can be found in Appendix E. Investigating forward citations and scanning reference lists of the included 12 articles resulted into the identification of a further two articles. A flow diagram of the inclusion process can be found in Figure 2.

Figure 2. Flow diagram of inclusion process



(Moher et al., 2009)

1.3.1 Study Characteristics

Characteristics of all 14 studies, including number of participants, analysis model, reported findings and effect sizes are shown in Table 2. Overall weight of evidence ratings is also shown. Nine were rated as high, (Aus, Jogi, Poom-Valickis, Eisenschmidt, & Kikas, 2017; De Kraker-Pauw, Krabbendam, Van Atteveldt, & Van Wesel, 2017; Deemer, 2000; Leroy, Bressoux, Sarrazin, & Trouilloud, 2007; Matteucci, Guglielmi, & Lauermann, 2017; Patterson, Kravchenko, Chen-Bouck, & Kelley, 2016; Shim, Cho, & Cassady, 2013; Stipek, Givvin, Salmon, & MacGyvers, 2001; Tiekstra & Minnaert, 2017); the remaining five yielded a medium rating (Chen, Fwu, Wei, & Wang, 2016; Jones, Bryant, Snyder, & Malone, 2012; Jonsson, Beach, Korp, & Erlandson, 2012; Lynott & Woolfolk, 1994; Rattan, Good, & Dweck, 2012).

Table 2. Study Characteristics

Authors & Date	Number of participants	Analysis model	Reported findings	Effect size	Overall weight of evidence
Aus, Jõgi, Poom-Valickis, Eisenschmidt & Kikas (2017)	118	Latent Profile Analysis Independent t-tests	Newly qualified teachers can be divided into two groups, one 'optimistic' with lower entity beliefs and one 'reserved' with higher entity beliefs	*d*=-2.56 Large	High
			Both groups did not significantly differ in incremental beliefs	*ns*	
		Independent t-test	Optimistic teachers promoted more mastery goals	*d*=0.58 Medium	
			Reserved teachers did not promote more performance goals.	*ns*	
Chen, Fwu, Wei & Wang (2016)	174	Structrual Equation Modelling	Entity beliefs are negatively predictive of favouritism, praise and long-term expectations of a hard-working but struggling student.	β=-0.44 -0.23 Small to Medium	Medium
			Entity beliefs predict favouritism of a non-working but high-achieving student	β=.31 Medium	

Deemer (2004)	99	Recursive Path Model	Higher scores for incremental beliefs of intelligence were associated with higher personal teaching efficacy, in turn predicting mastery goals	*r*=.021 Small	High
De Kraker-Pauw, Van Wesel, Krabbendam & Van Atteveldt (2017)	106	Multiple Linear Regression	Teachers with incremental mindset and female teachers appraised increasing achievement more than teachers with an entity mindset and male teachers. There were no differences between teachers of different subjects.	β=0.19 Small	High
	23	Bivariate Correlation	Teachers with a growth mindset gave less feedback overall	*r*=-0.43 Medium	
		Independent t-test	Male teachers gave more growth feedback than female teachers	*d*=0.90 Large	
		Independent t-test	Teachers of STEM subjects gave more growth feedback than non-STEM teachers	*d*=1.05 Large	
Jones, Bryant, Snyder & Malone, (2012)	270	Independent t-test, Bivariate Correlation	A majority of preservice and in-service teachers held incremental beliefs about intelligence, no difference between groups	*n.s*	Medium
Jonsson, Beach, Korp & Erlandson (2012)	226	ANOVA	Teachers overall showed a preference towards incremental theory of intelligence, but for maths and science teachers the difference with entity beliefs was not significant. No main effect of subject, but interaction age/experience	*r*=-0.52 Large	Medium

Leroy, Bressoux, Sarrazin & Trouilloud (2007)	336	Path Analysis	Incremental theory of intelligence is predictive of feeling of self-efficacy, which in turn predicts support for autonomy in the classroom	β=.22 Small	High
			Entity theory of intelligence has a negative impact on support for autonomy	β=-.18 Small	
			Seniority is associated with self-efficacy and support for autonomy, as well as with entity beliefs	β=.13 β=.21 *r*=.11 Small	
Lynott & Woolfolk (1994)	319	Bivariate Correlation	Teachers tended to hold incremental beliefs, but the range of beliefs is wide		Medium
			Negative correlation between experience and incremental beliefs	*r*=-.30 Medium	
Matteucci, Guglielmi & Lauermann (2017)	287	Path Analysis	Teachers' incremental theories contribute to feelings of personal responsibility	β=.13 Small	High

			This in turn is predictive of career-choice satisfaction, work engagement and mastery practices.	βs=.18, .11 and .20 Small	
			There is a direct effect of incremental theory on work engagement, as well as a marginal direct effect on mastery practices	βs=.11, Small	
Patterson, Kravchenko, Chen-Bouck & Kelley (2016)	126	ANOVA, Multiple Regression and MANOVA	Both pre-service and practising teachers tended to subscribe to incremental beliefs.		High
			Significant difference in implicit theories of intelligence between teachers of different subjects. Arts teachers held the most entity beliefs, followed by teachers of STEM and basic skills. Humanities teachers reported the lowest entity beliefs.	η^2_p=0.53 Large	
			Practising teachers who endorsed entity beliefs thought that student factors were less important for student success.	β=-.39 Medium	
			Both practising and pre-service teachers who endorsed entity beliefs thought that teacher factors were less important for student success.	β=-.22 Small	
			Entity views of intelligence were associated with ability based beliefs in basic skills, humanities and STEM, but not in arts or physical domains.	η^2_p=0.13 Small	

Rattan, Good & Dweck (2011)	41-95	Regressions and Independent t-tests	Entity theorists were significantly more likely to believe that a poor performing student was 'not smart enough'	*d*=0.97 Large	Medium
			Entity theorists were more likely to attribute a poor performance on a maths test to lack of ability, rather than lack of effort	*d*=0.87 Large	
			Entity theorist were more likely to endorse comforting practices and use teaching strategies that could reduce future engagement	*d*=0.82 Large	
Shim, Cho & Cassady (2013)	209	Multiple Regression	Teachers with an entity theory and performance-avoidance goals pursue fewer performance goals in the classroom, perhaps to protect student self-esteem	*n.s.*	High
Stipek, Givvin, Salmon & MacGyvers (2001	21	Bivariate Correlation	Teachers holding an entity theory of intelligence placed an emphasis on performance in their practice and on independence in their evaluations	*r*=0.53 Large	High
Tiekstra & Minnaert (2017)	101	Structural Equation Modelling	Implicit theories of intelligence play a prominent role in teachers' actions in the classroom. Teachers with an entity view were more consistent in their actions than teachers with an incremental view	β=.58 Large	High
			Implicit theories predicted the belief in IQ tests in support professionals, with entity theorists attaching more credibility to IQ tests. This relationship mediates the relationship with the belief in consequential validity of these tests.	β=.25 Small	

1.3.1.1 Quality

Of the fourteen articles that were included in the systematic literature review reported below, eight were judged to be of high methodological quality, according to the criteria of the adapted version of the quality assessment checklist developed by Downs and Black (1998) (Aus et al., 2017; De Kraker-Pauw et al., 2017; Deemer, 2000; Jones et al., 2012; Jonsson et al., 2012; Matteucci et al., 2017; Patterson et al., 2016; Shim et al., 2013). Of the remaining studies five were judged to be of medium methodological quality (Chen et al., 2016; Leroy et al., 2007; Lynott & Woolfolk, 1994; Stipek et al., 2001; Tiekstra & Minnaert, 2017) and one of low methodological quality (Rattan et al., 2012).

1.3.1.2 Focus

Three of the studies included in the review focused solely on comparing the implicit theories of intelligence of different groups of teachers; both Jones et al. (2012) and Patterson et al. (2016) compared preservice to in-service teachers, whereas Jonsson et al. (2012) explored the mindset of teachers by age and the subjects that they taught. Whilst the other studies included in this review might have also contained similar comparisons, they were additionally exploring the relationship of teachers' mindsets with either a form of goal setting (Aus et al., 2017; Deemer, 2000; Leroy et al., 2007; Lynott & Woolfolk, 1994; Matteucci et al., 2017; Shim et al., 2013; Stipek et al., 2001; Tiekstra & Minnaert, 2017) or feedback (Chen et al., 2016; De Kraker-Pauw et al., 2017; Rattan et al., 2012).

1.3.1.3 Study Design

All of the included fourteen studies used correlation designs to investigate associations between implicit theories of intelligence and other variables. The study by Aus, Jõgi, Poom-Valickis, Eisenschmidt and Kikas (2017) was the only one that had a longitudinal design, as measurements of implicit theories of intelligence and outcome expectations were correlated with teachers' reports of their approaches to instruction and classroom management one year later. De Kraker-Pauw, Van Wesel, Krabbendam & Van Atteveldt (2017) conducted two studies; in their second study they correlated teachers' mindset scores with results from video observations of feedback that these teachers gave to their students. In the studies by Chen, Fwu, Wei and Wang (2016) and Rattan, Good and Dweck (2012), teachers' mindset scores were correlated with their responses to a vignette. The research by Rattan et al. (2012) was the only study in this review which included an experimental study, in which an intervention designed

to prompt a fixed or growth mindset was used. These resulting mindsets were then correlated with participants' responses to a vignette describing a scenario in which a fictitious student had failed.

1.3.1.4 Samples

Sample sizes across the included studies ranged from 21 to 336. Two studies included preservice as well as in-service teachers (Jones et al., 2012; Patterson et al., 2016). The study by Rattan et al. (2012) included undergraduate students imagining themselves in a teaching role and the other studies involved teachers at primary (total *n*=859) and secondary schools (total *n*=1134). Only one study also involved special service co-ordinators and school psychologists, as well as teachers (Tiekstra & Minnaert, 2017). Reported data showed that 1777 were female and 744 were male; Tiekstra and Minnaert (2017) did not supply any information regarding gender of their participants. The amount of reported experience of in-service teachers varied widely, from zero to 41 years. Some studies did not disclose any information regarding teaching experience (Chen et al., 2016; De Kraker-Pauw et al., 2017; Lynott & Woolfolk, 1994; Tiekstra & Minnaert, 2017). Eight studies reported mean ages of the practising teachers; these means ranged from 25.94 to 49.95, with an overall mean of 38.94 years.

1.3.1.5 Measures of implicit theory of intelligence

Apart from additional measures, such as questionnaires or video observation data, all studies assessed the entity beliefs of teachers. Most studies used a version of an implicit theory of intelligence questionnaire developed by Dweck (2000) in order to do so, with either three, four, six or eight items. Lynott and Woolfolk (1994), on the other hand, used an 11-item questionnaire that they developed, based on the two views of intelligence, entity and incremental, as proposed by Dweck and Bempechat (1983, cited inLynott & Woolfolk, 1994). Stipek et al. (2001) also used an 11-item measure of mindset, embedded in a larger questionnaire, but they did not give any details of its origin. Leroy et al. (2007) used an abridged version of a questionnaire developed by Sarrazin et al. (1996, cited inLeroy et al., 2007). This scale includes innatist views, reflecting beliefs that intelligence is a result of natural giftedness, as well as entity and incremental beliefs, but Leroy et al. omitted the four items regarding innatist view. Aus et al. (2017) used the same questionnaire but did include these, which meant their questionnaire comprised a total of 12 items.

1.3.2 Findings

The research included in this review explored teachers' mindsets, as well as the influence of these mindsets on a number of pedagogical practices. This exploration resulted in a number of themes, summarised in Table 3 and detailed below.

Table 3. Summary of themes

Topic	Studies
Teachers' Implicit Theory of Intelligence	Aus et al (2017), Chen et al. (2016), Deemer (2004), De Kraker-Pauw et al. (2017), Jones et al. (2012), Jonsson et al. (2012), Leroy et al. (2007),), Lynott & Woolfolk (1994), Matteucci et al. (2017), Patterson et al. (2016), Shim et al. (2013), Stipek et al. (2001)
Implicit theory and teachers' age and/or experience	Jones et al. (2012), Jonsson et al. (2012), Lynott & Woolfolk (1994), Patterson et al. (2016),
Implicit theory and teachers' gender	De Kraker-Pauw et al. (2017)
Implicit theory and subject of teaching	De Kraker-Pauw et al. (2017), Jonsson et al. (2012), Patterson et al. (2016),
Implicit theory and teachers' self-efficacy	Aus et al (2017), Deemer (2004), Leroy et al. (2007), Matteucci et al. (2017),
Implicit theory and evaluation of students by the teacher	Chen et al. (2016), De Kraker-Pauw et al. (2017), Rattan et al. (2012), Stipek et al. (2001)
Implicit theory and goals in the classroom	Aus et al (2017), Deemer (2004), Leroy et al. (2007), Lynott & Woolfolk (1994), Matteucci et al. (2017), Rattan et al. (2012), Shim et al. (2013), Stipek et al. (2001), Tiekstra & Minnaert (2017)

1.3.2.1 Teachers' implicit theories of intelligence

Most of the studies included in this review, apart from Rattan et al. (2012) and Tiekstra and Minnaert (2017), detailed descriptive statistics of teachers' mindsets. Overall, teachers tended to subscribe to incremental rather than fixed views. This was not the case in the study by De Kraker-Pauw et al. (2017), where teachers' mindsets were reported as marginally fixed, and Aus et al. (2017), where 59% of their sample were inclined towards entity beliefs.

1.3.2.2 Implicit theories and teaching experience or age

A number of studies have compared the mindsets of more experienced teachers with those of less experienced teachers, but have found no significant differences. Both Jones et al. (2012) and Patterson et al. (2016) compared implicit theories of preservice teachers with in-service teachers and found that both groups did not differ in mindset scores. It is important to take into account that, in both studies, the difference in teaching experience between the groups may not have been significant enough. For example, in the study by Jones et al. about half of the in-service teachers had less than seven years of experience. Furthermore, those teachers, as well as the preservice teachers in their study, were all enrolled on a university course, therefore perhaps sharing similar characteristics. Similarly, the participant groups of Patterson et al. showed overlaps; preservice teachers could have up to two years of experience, whereas some in-service teachers had only one year of teaching experience. The blurring of the distinction between preservice and in-service teachers in both studies arguably makes it difficult to draw any conclusions, but it may explain their non-significant findings. Even so, in a study with only practising teachers, Jonsson et al. (2012) did not find an effect of experience on teachers' implicit theories of intelligence, either. They avoided blurring the distinctions between groups by performing a split-half method according to median years of experience. This meant that there was a group with more than, and a group with less than, 13 years of experience. Despite having clearer group boundaries, there were no significant differences in mindset between both groups and consequently this corroborates the evidence of Jones et al. (2012) and Patterson et al. (2016). In contrast, Lynott and Woolfolk (1994) did find an association between experience and mindset: the more experienced teachers were, the more they believed intelligence to be a fixed trait. A strength of the study by Lynott and Woolfolk was that they divided the teachers into four groups according to years of experience, which arguably allowed for a finer-grained analysis of the impact of experience on mindset. Yet this study was considered of lower methodological quality than the studies by Jones et al. (2012), Jonsson et al. (2012) and Patterson et al. (2016), due to lack of clarity in reporting and low internal validity, lending less credence to its results.

Because age and experience of teachers were significantly correlated, Lynott and Woolfolk (1994) explored the relationships between experience and mindsets by age group. Interestingly, they found that for teachers older than 50, greater experience equated to more fixed mindsets, whereas this was not the case in

other age groups, pointing to an interaction effect of age and experience on mindset. Lynott and Woolfolk investigated this only by looking at correlations, rather than through conducting an Analysis of Variance (ANOVA), which may have been more appropriate. Indeed, Jonsson et al. (2012) did conduct an ANOVA. Similar to Lynott and Woolfolk, they found an interaction between age and experience; not only did older teachers with more experience prefer an entity theory of intelligence, so did younger teachers with less experience. Conversely, there were no significant effects of age or experience on incremental beliefs. As this was a study of high methodological quality, this supports the notion that age and experience have an interactive impact on teachers' implicit theories of intelligence. Still, more research needs to investigate why these identified groups in particular may favour a fixed over a growth mindset, as well as how incremental views can be supported in all teachers.

1.3.2.3 Implicit theories and gender

All of the researchers, apart from Tiekstra and Minnaert (2017) described the gender characteristics of their participants. Surprisingly, whilst De Kraker-Pauw et al. (2017) used this as a part of their analysis, this was not the case in any of the other studies. The descriptive statistics in the study by De Kraker-Pauw et al. showed that the female teachers in their sample were more oriented towards a growth mindset than the male teachers, but this difference was not statistically significant. De Kraker-Pauw et al. also measured teachers' appraisal of increasing achievement. This meant that teachers were shown students' results on three tests and they had to evaluate the marks on the third test, which for some students signified an improvement, even though the final mark was insufficient. Female teachers' appraisal of increasing achievement was higher than those of male teachers and, in contrast with growth mindset scores, the difference was statistically significant. In their second study De Kraker-Pauw et al. found that whilst male and female teachers provided similar amount of feedback, male teachers provided more growth feedback. This means that they commented significantly more on how students had achieved results, rather than commenting on the results itself. This seems surprising in light of the first study, in which female teachers were more oriented towards growth than their male colleagues. Although only 22 percent of the original sample took part in the second study, De Kraker-Pauw et al. compared both samples and found no difference in mindset scores or appraisal of achievement, which means we can be confident that it is possible to draw inferences from the first to the second study. The first study was a vignette study, whilst the second was based on video observations and

therefore arguably a better representation of actual practices in the classroom. Furthermore, it is possible that there was an interaction effect of mindset and gender on the type of feedback given by the teacher, but this remained unexplored in this study. De Kraker-Pauw et al. have therefore hinted at gender differences with regards to mindset and subsequent practices, but research in this area is sparse and so far the evidence does not yet lead to any firm conclusions on the possible interactions between gender, mindset and subsequent pedagogical practices.

1.3.2.4 Implicit theories and teaching subject

So far the discussion has focused on teachers' general implicit theories of intelligence. However, efforts have also been made to understand the role that this may play within a range of domains, as this may underpin teaching practices in different subjects (Patterson et al., 2016). Jonsson et al. (2012), for example, compared the implicit theories of teachers of maths and science, language, social science and practical subjects. They found that maths and science teachers endorsed fixed mindset and growth mindset beliefs to a similar extent. This was in contrast with the teachers of other subjects, whose endorsement of growth mindset beliefs was significantly higher. This, therefore, showed a different pattern of endorsement of beliefs between teachers of the Science, Technology, Engineering and Maths (STEM) domain and non-STEM subjects. Also, STEM teachers' mean score for endorsement of fixed beliefs was higher than the mean score of non-STEM teachers. Nevertheless, the ANOVA that Jonsson et al. (2012) conducted resulted in a non-significant main effect of discipline for implicit theories of intelligence. As such, their conclusion that maths and science teachers were significantly different from teachers of other subjects on these measures is an overstatement of their results.

De Kraker-Pauw et al. (2017) found that teachers of the Science, Technology, Engineering and Maths (STEM) domain were more inclined to endorse fixed mindset beliefs than teachers of non-STEM domains, but this was not at a significant level. Neither was there a significant difference in the appraisal of increasing marks, regardless of students' final marks. In their second study, De Kraker-Pauw et al. did find a significant negative correlation between growth mindset and amount of feedback offered to students; teachers with stronger fixed beliefs offered more feedback overall. Interestingly, they also found that STEM teachers provided statistically significant more growth feedback than non-STEM teachers. The effect of this difference was large (d=1.05). This means that

in their sub-sample of 22 participants there was no negative association between the endorsement of fixed mindset beliefs and the use of growth feedback. This is opposite to the expected direction, but De Kraker-Pauw et al. did not explore this further. Their finding suggests however that reported implicit beliefs do not necessarily associate with actual practices in the classroom. De Kraker-Pauw et al. justly identified that there was an association between gender and subject in their sample, as there were more male teachers in the STEM than in the non-STEM domain and male teachers were found to give more growth feedback. Without further exploration of the interaction between gender and subject, it is difficult to pinpoint which of the two factors was most influential on this higher rate of growth feedback to students.

Whilst the studies by Jonsson et al. (2012) and De Kraker-Pauw et al. (2017) tried to understand the mindsets of teachers of different subjects, Patterson et al. (2016) asked teachers, regardless of their subject of teaching, to what extent they attributed success in different domains to natural ability, rather than practice. Ability-based attributions were highest for the arts. That was followed by ability attributions in STEM domains, physical domains and basic skills; for humanities, ability attributions were lowest. The effect of domain on type of attribution was large ($\eta^2_p = 0.53$). Interestingly, Patterson et al. found a partial interaction with teachers' general implicit theories: participants with a fixed mindset made stronger ability attributions in the domains of STEM, humanities and basic skills. This was not the case for the arts and physical domain.

In summary, there is some evidence to suggest that teachers in STEM domains may endorse entity beliefs to a somewhat greater extent than teachers in different domains, but the difference is not necessarily significant. Furthermore, classroom practice may not be in accordance with such beliefs; in fact, the use of feedback may be in the opposite direction to that predicted. There is stronger evidence that teachers may use different attributions for different subjects and that this is influenced by their implicit beliefs about intelligence more generally.

1.3.2.5 Implicit theories and self-efficacy

Four studies considered the impact of teachers' mindsets on their feelings of self-efficacy, which, in turn, was associated with teachers' affection for students (Aus et al., 2017), mastery practices (Aus et al., 2017; Deemer, 2000), support for students' autonomy (Leroy et al., 2007) and sense of personal responsibility for student outcomes (Matteucci et al., 2017). Aus et al. (2017) conducted a latent profile analysis, which led to the distinction between two groups of teachers. The

first had higher levels of entity beliefs and lower self-efficacy, which they classified as 'reserved'. The second reported with lower levels of entity beliefs, lower endorsement of the view that ability is innate, or the result of natural giftedness, and higher self-efficacy, which they named 'optimistic'. The difference in endorsement of entity beliefs between both groups was very large (d=-2.56). Comparison of the means in self-efficacy of these groups also showed a large effect (d=0.86). Both Deemer (2004) and Leroy et al. (2012) also found that incremental views on intelligence were a significant contributing factor for self-efficacy, although in their studies the effect sizes were small (r=.21and β=.22 respectively). Matteucci et al. (2007), conversely found only a marginally significant association between teachers' incremental beliefs and their self-efficacy. The studies by Deemer, Leroy et al. and Matteucci et al. were comparable in design, as they all involved a path analysis. Even though all three were classified as 'high' on the overall weight of evidence scale (Gough, 2007), it is worth noting that the study by Matteucci et al. was judged to have higher methodological quality, which adds to its persuasiveness. Nevertheless, arguably the study by Patterson et al. (2016) also points to the impact of implicit theories of intelligence on teacher self-efficacy, even if it was not measured with a dedicated scale. In this study, teachers with a fixed mindset, when compared with teachers with a growth mindset, were less inclined to see their own influence, such as their classroom and quality of teaching as important for student success. Patterson et al. proposed that this may be because these teachers feel that they cannot influence their students' achievements greatly. Similar to the studies by Deemer and Leroy et al, the effect size in their study was also small. Taken together, the evidence suggests that incremental beliefs make a significant contribution to teachers' self-efficacy, which in turn has a positive impact on practices in the classroom. Within the research there are some inconsistencies regarding the size of this effect, but it is most likely to be small.

1.3.2.6 Implicit theories and evaluation of students by teachers

Hong, Chiu, Dweck, Lin and Wan (1999) proposed that people's implicit theories form part of a meaning system, within which they make attributions in the social world. Following this line of reasoning, this should mean that the implicit theories held by teachers inform the way they assess and evaluate the efforts and performance of those they teach. A number of studies have investigated this proposition. Rattan et al. (2012), for example, conducted a simulation experiment, in which undergraduate students had to imagine themselves in the role of a maths teacher and had to explain why a fictional student had not

performed well in a test. They found that entity theorists were more likely to believe that this was due to a lack of smartness in maths. Their second study, in which participants read an article designed to prompt either a fixed or growth mindset, confirmed these results; the difference between entity and incremental theorists was large, d=0.97. There were similar results in a third sample, this time of graduate student instructors. Instructors with entity beliefs also held lower expectations for future performances for this fictional student, based on the results of just one test. Chen et al. (2016) also used vignettes, this time to describe two students: one hard-working but struggling student, and one non-working but high-achieving student. They also found that teachers with a fixed mindset had lower expectations for future performances for the struggling student, although this association existed for long-term expectations only. In contrast, entity theory was not associated with expectations for the non-working high-achieving student at all, either long-or short-term. In addition to this, Chen et al. found that teachers' reported mindsets were predictive of which student they favoured. Fixed mindset beliefs predicted teachers' favouring the high-achieving student, even though this student was described as not working hard. On the other hand, fixed mindset beliefs were negatively predictive of the extent to which the hard-working but struggling student was favoured. Also, teachers with a fixed mindset were shown to be less likely to praise the struggling student.

Although the study by Rattan et al. (2012) showed significant results, with large effect sizes, it is important to bear in mind that the methodological quality of this paper was judged to be low. The participants in this study were largely not teachers, but participants imagining themselves in a teaching role, which reduced its external validity. The overall weight of evidence (Gough, 2007) for this paper, in the context of this review, was therefore judged to be medium. Chen et al. (2016) proposed that in East Asian contexts, such as Taiwan, there is a strong influence of Confucian cultural traditions. Part of this is the belief students are obliged to study hard. This is why they chose not to use a dichotomous model, in which entity theories are contrasted with incremental theories, but to include obligation-oriented as well as improvement-oriented beliefs about effort. They point out that in their sample improvement-oriented beliefs, which are described in such a way that they seem similar to incremental theories, are not negatively correlated with entity beliefs. This is in contrast with other studies included in this review (see for example Jonsson et al., 2012) and casts some doubts over the similarity between the epistemological constructs used by Chen et al. and those

in other studies. As a consequence, the overall weight of evidence (Gough, 2007) of the study by Chen et al. was also judged to be medium.

Stipek et al. (2001) on the other hand did use a dichotomous model of entity and incremental beliefs and the overall weight of evidence (Gough, 2007) was judged to be high. They investigated what teachers with different implicit theories would find important in their formal evaluations of students. They found an association between teachers' endorsement of fixed mindset beliefs and their valuing of students' independence. This was in a different direction to their prediction, as they expected independence to be associated with inquiry-oriented behaviours and initiative in learning, which seemed to fit better with an incremental mindset. Stipek et al. reasoned that, as they did not articulate the concept of independence clearly in their measures, perhaps the teachers interpreted independence to mean an opposite of asking questions to, or depending on, the teacher. They argued that this kind of independence would suit the more traditional teaching style better, which focuses on getting correct answers. As such, it would fit into a fixed mindset belief system. Whilst this may be plausible, it remains speculative to explain results opposite to the hypothesised relationship in this way. It can therefore not be seen as conclusive evidence of the link between entity beliefs and an emphasis on independence.

De Kraker-Pauw et al. (2017) also found results that were contrary to their prediction: they found that teachers with a growth mindset provided significantly less feedback overall to students than teachers with a fixed mindset. Unlike Stipek et al. (2001), who speculated on the clarity of their measures, they reasoned instead that self-reported mindset of teachers may not be congruent with their behaviours in the classroom. This would fit well with the notion of the social desirability of incremental mindsets, which could skew the results of studies that aim to investigate teachers' mindsets (Aus et al., 2017). De Kraker-Pauw et al. also found that teachers with a growth mindset appraised increasing achievements of students higher than teachers with a fixed mindset. However, they found no evidence that teachers with a growth mindset were more likely to give growth-oriented feedback. The high methodological quality of their paper and high overall weight of evidence (Gough, 2007) mean that this study makes a valuable contribution to the available evidence in this area.

In short, there is some evidence that teachers' mindsets influence their evaluations of students' successes and failures. We can also have some confidence that implicit theories influence the kind of students that teachers may

like to work with and what they expect the outcome of that work to be. Finally, research has provided support for the notion that teachers' mindsets do contribute to the amount of feedback they give, but not the type of feedback.

1.3.2.7 Implicit theories and goals in the classroom

Different beliefs about one's intelligence, either as fixed or as malleable, have consequences for one's personal goals; where entity theorists tend to adopt performance goals, incremental theorists tend to adopt learning goals (Dweck & Leggett, 1988). This framework, developed by Dweck and Leggett (1988), considers the relationship between implicit theories and individual goals, but a number of studies have investigated if this can be extrapolated to the goals that teachers set for their students in the classroom. The results of these investigations have been mixed. For example, Lynott and Woolfolk (1994) found no significant association between teachers' implicit theories about the nature of intelligence as either malleable or fixed and how high they rated the importance of practical, academic, conceptual or social goals within education. Whilst Lynott and Woolfolk looked at the association between teachers' mindsets and goals in these areas, they did not make a distinction between performance goals or mastery goals within those. This perhaps explains why they did not find any significant correlations, where other studies have. Aus et al. (2017) focused specifically on teachers' approaches that promoted mastery goals, such as recognising students' individual progress even if the level of attainment is low, or performance goals, such as displaying the work of the highest achieving students, respectively. They found teachers that they classified as 'optimistic' were significantly more likely to use teaching strategies that promoted students' mastery goals, with medium effect size (d=0.58). Interestingly, both groups were similar in their promotion of performance goals.

This contrasts with the study by Stipek et al. (2001), in which there was only a marginally negative association between entity beliefs and mastery practices, whereas teachers with entity beliefs did emphasise performance in the classroom. Stipek et al. based their findings on video observations, rather than on teachers' self-reports, as was the case in Aus et al. As such, these may be a more reliable measure of teachers' behaviours in the classroom. Furthermore, the coding of the videos had high interrater reliability, which increases confidence in the robustness of these findings.

Shim et al. (2013) used the same scale as Aus et al. (2017) to measure teachers' mastery and performance goal orientation, but found no significant direct effect

of theory of intelligence on promotion of either mastery or performance goals. The reasons for the difference between the results of both studies is not clear. Although Aus et al. use latent profile analysis and comparison between groups and Shim et al. conducted multiple regressions, this should not account for the strikingly different results. Perhaps the explanation should be sought in the difference in samples: where Aus et al. used novice teachers, the participants of Shim et al. were experienced teachers. As such, perhaps they were more proficient in accurately reporting on their classroom goals. Shim et al. (2013) did, however, find an interaction effect: teachers with a fixed mindset who endorsed performance-avoidance goals, such as not wanting to look incompetent, were less likely to promote performance goals for their students. Shim et al. acknowledged that this seemed counterintuitive; they speculated that those teachers may want to protect their own and their students' self-esteem by deemphasising social comparisons. Whilst this needs further investigation, their reasoning seems plausible; teachers who want to avoid looking incompetent would avoid creating situations in which their students are likely to fail. This shows some similarities with the study by Rattan et al. (2012); after a disappointing student performance, participants with a fixed mindset were more likely to engage in teaching activities in which a repeat of such a failure would be avoided. For example, they would assign less homework in future.

The responses of the teachers in the research by Rattan et al. (2012) and Shim et al. (2013) were therefore considered to be protective of self-esteem, either that of the teacher or the student. Tiekstra and Minnaert (2017), however, focused on how teachers, and support professionals, may respond to students who are classified as at-risk, to support them in their learning progress. More specifically, they investigated whether or not the implicit theories of intelligence influenced the actions that educational professionals take. They found that there was a large correlation between teachers' mindsets and actions (β=.58). This association was even larger in denominational schools with religious affiliation, compared with in public schools. The more teachers endorsed entity beliefs, the more consistent they were in their actions towards these students. Tiekstra and Minnaert pointed towards the dangers of this; they argued that as these actions are in line with teachers' fixed mindsets, at-risk students could be stigmatised and could become the victim of self-fulfilling prophecies. Remarkably, teachers with an incremental mindset, on the other hand, were less consistent in putting this into action (Tiekstra & Minnaert, 2017).

This disconnect between incremental mindset and concordant actions has also been found in other research. Deemer (2000) for example failed to find a direct link between teachers' growth mindset and their use of mastery practices. Whilst her analysis did not have enough power to detect significant effects, Matteucci et al. (2017), whose study was sufficiently powered, did not find a direct association either. Similarly, Leroy et al. (2007) failed to find a direct link between teachers' incremental mindset and their support for students' sense of autonomy and subsequent intrinsic motivation. Instead, in these studies incremental views contributed to teachers' self-efficacy (Deemer, 2000; Leroy et al., 2007) and feelings of personal commitment to students' success (Matteucci et al., 2017), which in turn did predict mastery and autonomy supportive practices. Intriguingly, Leroy et al. found that teachers' entity views had a direct, but negative, effect on autonomy support. This echoes the findings of Tiekstra and Minnaert (2017), in that incremental beliefs did not lead to consistent practices, whereas entity beliefs did.

In summary, the evidence for a direct beneficial impact of teachers' incremental mindset on their adoption of mastery goals is so far sparse. Instead, it seems that the absence of a fixed mindset is predictive of teachers' mastery orientation. Additionally, the available evidence points towards the influence of entity beliefs on teachers' actions in the classroom, but the effects of this are not yet entirely clear. There are some suggestions that teachers' fixed mindsets lead them to adopt performance goals (Stipek et al., 2001); equally there are some suggestions that the opposite is true and that it leads teachers to discourage performance goals to their students (Rattan et al., 2012; Shim et al., 2013) as well as discourage students' autonomy (Leroy et al., 2007). Finally, there are worrying signs that teachers' entity beliefs can lead to more consistent, and potentially damaging, actions for students, whilst teachers find it more difficult to put their incremental mindsets into practice (Tiekstra & Minnaert, 2017).

1.4 Discussion

A systematic literature review was conducted to investigate what is known about the implicit theories of intelligence that teachers tend to subscribe to and how these theories influence their pedagogical practices in the classroom. All studies included in this review used a self-report measure to assess teachers' mindsets. Conceptually there was a difference between the studies that used three or four items to measure mindset, which measure entity beliefs only, and the studies that

used six or eight item measures, which capture incremental beliefs as well. An absence of a fixed mindset, as measured through a three-item implicit theory of intelligence questionnaire, does not necessarily imply the presence of a growth mindset. Higher scores on this questionnaire represent one side of a sliding scale, for example a growth mindset, whilst lower scores represent the other, for example a fixed mindset. Some scores may be close to the mean of the scale, therefore not strongly representing either. However, according to Dweck, Chiu and Hong (1995), inclusion of incremental items may be problematic, because they may seem more compelling and therefore achieve high levels of agreement. Interestingly, in this review the only two studies that identified teachers' implicit theories as tending towards entity beliefs (Aus et al., 2017; De Kraker-Pauw et al., 2017) both used a six-item measure that did include incremental beliefs. As such, the concern that including incremental statements in the measure could skew results may be unwarranted.

Apart from Aus et al. (2017) and De Kraker-Pauw et al. (2017), all studies found that teachers tend to favour an incremental mindset, which means that teachers believed that intelligence is malleable and can increase. Jones et al. (2012) speculated that teachers may be more likely to believe that everyone is capable of learning. This seems consistent with the theory of cognitive dissonance (Festinger, 1957); teachers who believe that a student cannot learn would feel dissonance with the amount of effort they put into teaching. However, others point to the social desirability of responding in a way consistent with an incremental mindset (Aus et al., 2017). This would mean that some teachers may have held fixed mindsets, but misreported their beliefs to be in line with a growth mindset, either deliberately or because of unconscious processes. Additionally, the social desirability of a growth mindset may have led to a participation bias, as teachers who hold fixed beliefs may have been reluctant to participate in research (Lynott & Woolfolk, 1994). Only a few studies in this review reported response rates; of those that did, Jones et al. (2012) reported a 100% response rate, but others varied between 40.4 and 64 percent (Lynott & Woolfolk, 1994; Matteucci et al., 2017; Shim et al., 2013; Tiekstra & Minnaert, 2017). The reasons for these lower response rates cannot be attributed conclusively to a response bias on the basis of mindset, as it is not possible to ascertain the mindset of those that did not take part in the research. Nevertheless, the possible presence of both response bias and participation bias within the included research indicates that caution is needed in drawing strong conclusions about the impact of teachers' mindset on pedagogical practices. The social desirability effect also brings into

question the validity of using a self-report measures for assessing mindsets. Research from a different epistemological viewpoint is needed to address at least some of these concerns. Whilst participation bias remains an issue, the use of implicit measures instead of self-report for example, such as that used in the study by (Mascret, Roussel, & Cury, 2015), may be a novel and valuable tool for assessing implicit theories of intelligence in a way that is less vulnerable to social desirability effects. This also seems to be more consistent with the assumed implicit nature of fixed and growth mindsets.

Within the reviewed research, there was no conclusive evidence that teachers' gender was of significance on their implicit beliefs of intelligence. This differs from research that found that boys in the sixth and eighth grade (equivalent to Years 7 and 9 in the United Kingdom) were significantly more likely to endorse incremental beliefs than girls in the same age group (see for example Diseth, Meland, & Breidablik, 2014). The review did show some evidence, however, that the age and experience of teachers impacted on the implicit theories they favoured; specifically, younger inexperienced teachers and older experienced teachers were more likely to endorse a fixed mindset. The reasons why this might be the case is yet to be explored. In the United Kingdom, data on all schools are collected and made public by Ofsted in a performance table ("Find and compare schools", 2018). Internationally, schools can be compared over time and with schools from different countries (OECD, PISA, 2018) Perhaps such measurements create a culture, within our education system, that values performance, rather than processes. As performance goals have been linked with fixed mindsets (Dweck & Leggett, 1988), it would be worth investigating if this contributes to the erosion of teachers' incremental mindsets over time. However, this does not fully explain the interactive effect of age and experience on the formulation of teachers' mindset and this deserves attention in future research.

There was little evidence that of an association between teachers' mindsets and their teaching subject. Whilst teachers of STEM subjects showed higher endorsement of entity beliefs than non-STEM subject teachers, this was not at a statistically significant level (De Kraker-Pauw et al., 2017; Jonsson et al., 2012). Although, interestingly, when Jonsson and Beach (2017) investigated the effects of exposure to different subjects on students' mindsets in a secondary school, they found that after a period of three years in a natural science stream, students reported significantly higher entity beliefs than the students in the aesthetic subject and social science programmes. This suggests that a prevalence of entity beliefs may exist in the STEM domain. The origins of this prevalence are not

entirely clear; for example, De Kraker-Pauw et al. (2017) found that STEM teachers gave more growth feedback than teachers in other subjects, a practice that does not suggest these teachers had a fixed mindset. On the other hand, Mascret et al. (2015) used an implicit association test to uncover the implicit theories of STEM and non-STEM teachers. Their study indicated that STEM teachers were more likely to take actions in line with holding entity beliefs; science teachers, compared to non-STEM teachers, showed a stronger negative implicit association between words indicating the concept of intelligence and words indicating modifiability. This was subject to an interaction effect, as this was especially true for male science teachers. More research is therefore needed to understand the espoused, as well as implicit, theories of teachers with regards to different subjects. This is important, especially in light of concerns about the diminished uptake of STEM courses (Dow, 2006), to investigate whether or not a prevalence of fixed mindsets within this domain leads some children to believe that they do not have the ability to study these subjects.

Overall the studies in this review indicated that having incremental beliefs about intelligence may contribute to teachers' self-efficacy, although the size of this effect varied across studies. Bandura (1982, p. 122) stated that "self-efficacy is concerned with judgments of how well one can execute courses of action required to deal with prospective situations". For teachers, the feeling that students' intelligence is malleable therefore seems to contribute to the feeling that they will be able to teach their students because their students have the capacity to learn. Other research has shown that after a ten-week growth mindset intervention, students' mindsets shifted towards more incremental beliefs and as a result, these students reported significantly higher levels of self-efficacy (Bedford, 2017). The association between teachers' growth mindset and self-efficacy is therefore consistent with research focused on student mindsets.

There was some evidence within the included studies that teachers' mindsets influence the judgements they make about their students' performance (Rattan et al., 2012). This could lead teachers with entity beliefs to lower their expectations of students who under-perform, as they ascribe this under-performance to a lack of ability. This is problematic, as teachers' expectations have been found to be associated with their students' achievements (Friedrich, Flunger, Nagengast, Jonkmann, & Trautwein, 2015). Tiekstra and Minnaert (2017) point out that this may be especially the case for teachers who work with at-risk students, who are facing difficulties in their learning; these students may therefore be stigmatised as a result.

Collectively, the data in this review also support the notion that teachers' mindsets have some impact on the goals that teachers set in the classroom. However, the evidence for the damaging influence of entity beliefs appeared to be stronger than the beneficial influence of teachers' incremental views. Research on the effects of different types of praise on children's academic behaviours seems to echo this, as it shows a similar pattern; Mueller and Dweck (1998) and Pomerantz and Kempner (2013), quoted in the introduction, for example, found that praise for intelligence led to ability attributions and lower persistence, whilst praise for effort did not lead to more effort attributions or higher task persistence or preference for challenge.

Perhaps the benefits of teachers' growth mindsets have not yet been evidenced because false reporting, due to social desirability effects, has distorted the pattern of association between mindset and pedagogical practices that do actually exist; hence the need for research from a different epistemological position. Alternatively, it may be that teachers do not always know how to translate incremental beliefs consistently into practice, as Tiekstra and Minnaert (2017) suggest. Whatever the case, it seems to be important to avoid an entity view of intelligence, even if the evidence of the beneficial effect of an incremental mindset has not yet been proven unequivocally.

1.5 Limitations

As with all research, there are some limitations to this review. Data extraction was handled by one researcher. Whilst the data were checked a few times after extraction, arguably this is less reliable than conducting the review with a team of researchers. This review also only included research published in peer-reviewed journals. This meant that some research, to date only available as doctoral theses for example, was not taken into consideration. If some of the unpublished theses had been included, this would have afforded some insights from qualitative research (see for example Calisto, 2014) and possibly allowed a richer and less biased understanding of the topic. Also, although references and forward-citations were used for a hand-search to find additional articles, and this resulted in two additional studies, it is possible that some relevant research has been missed. As it stands, all included studies relied on the self-reporting of teachers' mindsets by using questionnaires, which means there was a risk of social-desirability bias within the studies. Furthermore, within the included research the uptake of participants was low in some studies. For example, in the study by

Tiekstra and Minnaert (2017) only 40.4 per cent of invited people agreed to take part. This poses another potential risk of bias; it is possible that, for example, teachers with an entity view of intelligence chose not to take part, thereby skewing the results. Caution must therefore remain when considering this review.

1.6 Conclusions and recommendations

This review has built on the existing evidence regarding implicit theories of intelligence, by specifically focusing on the mindset that teachers bring to the classroom and the effects this has on their practice. The review showed that teachers tended to report an incremental mindset. However, they did so through self-reports on short questionnaires, which is not a comprehensive investigation of their beliefs. Future research should focus on verifying such self-reports by conducting qualitative studies, where these beliefs can be investigated in much more detail and to greater depth. Additionally, another valuable tool could be the use of implicit measure to assess teachers' mindsets, which avoids the risk of social desirability bias in teachers' responses.

Evidence from this review suggests that the damaging effects of teachers' fixed mindsets on their practice in the classroom may be clearer than the beneficial effects of an incremental mindset. Worryingly, it also seems that fixed mindsets lead to more consistent actions in the classroom. It is therefore worthwhile to support teachers' growth mindset even in the absence of clear evidence of its benefits, as we cannot cultivate the absence of a belief.

Educational psychologists can make a valuable contribution, not only through delivering training on implicit theories of intelligence, but also by encouraging and supporting teachers to reflect on their own implicit beliefs and to reflect on how these may impact their practice in the classroom. Some teachers -younger inexperienced, and older experienced teachers- seem to need such support more than others. Future research should tease out why specifically those groups are more vulnerable to entity beliefs and how their incremental beliefs can be best encouraged.

Although the research showed a link between teachers' mindsets and their goals, the association did not seem to be very strong, suggesting that there are other contributing factors at play. Perhaps implicit theories of intelligence do not always translate directly into concordant practice, as Haimovitz and Dweck (2017) proposed. Perhaps not only teachers' mindsets, but also other theories, such as

what it means to fail (Haimovitz & Dweck, 2016), influence teachers' pedagogical practices in the classroom. The studies included in this review assessed teachers' mindsets and pedagogical practices as reported by teachers, but we also need to know how these are perceived by their pupils. My empirical study will therefore investigate how teachers' reported implicit beliefs about failures, as well as their reported implicit beliefs about intelligence, relate to how their pupils perceive their practice, as well as what this means for how these pupils fare in the classroom as a result.

Chapter 2 An investigation into the associations between maths anxiety in secondary school pupils and teachers' and parents' implicit theories of intelligence and failure

2.1 Introduction

In many countries, there is a focus on raising participation and attainment in maths (Dowker, Sarkar, & Looi, 2016). One of the factors that can negatively influence such attainment is maths anxiety. Maths anxiety has been defined as involving "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). Across the countries of the Organisation for Economic Cooperation and Development (OECD) maths anxiety was found to be associated with an average decrease in maths performance of 34 score points, which equates to almost one year of schooling. In the United Kingdom this decrease was shown to be even larger, at 40 score points (OECD, 2012). The negative impact of maths anxiety has been demonstrated in children as young as seven years of age, even when they were achieving at age-related expectation or above (Wu, Barth, Amin, Malcarne, & Menon, 2012). Whilst maths anxiety may reduce maths achievement, the direction of causality may also be the reverse. Maloney, Levine, Beilock, Ramirez, and Gunderson (2015), for example, found that lower achievements in maths led to higher levels of maths anxiety in children. A recent meta-analysis highlighted several studies that have found that links between anxiety and underachievement are mediated by working memory (e.g., Owens, Stevenson, Hadwin, & Norgate, 2008) and it showed a consistent association between anxiety and lower measures of working memory capacity (Moran, 2016). Some researchers have argued that maths anxiety has been shown to be specific and subject related, rather than associated with general trait anxiety. Punaro and Reeve (2012), for example, showed that although children also reported worries about difficult literacy tasks, levels of worry were specifically higher for maths.

2.1.1 Influences on maths anxiety

As maths anxiety impacts negatively on maths achievement, researchers have focused on understanding factors that influence how it develops and is sustained. For example, Devine, Fawcett, Szűcs, and Dowker (2012) investigated the influence of gender on levels of maths anxiety in a sample of secondary school pupils. Importantly, this study controlled for trait anxiety, which can be seen as a strength of their research. They found that girls showed a higher level of maths anxiety than boys. Also, only for girls was maths anxiety related to a reduced performance in the subject. Interestingly, performance in maths did not differ between genders. Devine et al. (2012) reasoned that girls may have a higher aptitude for maths, but their higher levels of maths anxiety brings them in line with the performance of boys.

Apart from gender, age may play a role in the manifestation of maths anxiety. Although maths anxiety does occur at a young age (Wu et al., 2012), it has been found to increase as children get older (Dowker et al., 2016). This increase may be because of longer exposure to negative attitudes around maths, stereotypical thoughts about the difficulty or gender specificity of maths, or because of the experience, or threat, of failure experiences (Dowker et al., 2016). A meta-analysis of research about different types of anxiety showed that the mean age of onset was above 10.6 years of age (de Lijster et al., 2017). The increase in maths anxiety during childhood appears to follow a similar trajectory as general anxiety more broadly, emerging in late childhood and increasing into adolescence (Dowker et al., 2016).

In considering the relative roles of genes and the environment on explaining variation in maths anxiety in 12-year-olds, Wang et al. (2014) found, in a twin study, that about 40 per cent of maths anxiety could be explained by genetic factors, whilst 60 per cent could be attributed to child-specific environmental factors. Similarly, Maloney et al. (2015), investigated environmental factors. They studied the influence of parents on maths anxiety and achievement, and found that parental maths anxiety was negatively associated with their child's maths achievement. This was only the case if parents were frequently involved with their child's homework, indicating some transmission of anxiety through modelling or negative verbal information. Dowker et al. (2016) point to the importance of further investigating the role that the focus on achievement, not only by parents but also by teachers, may play in the development of maths anxiety. Arguably,

the extent to which parents and teachers focus on achievement in maths may be underpinned by their underlying implicit beliefs about maths intelligence.

2.1.2 Mindsets and maths anxiety

Mindsets, or implicit theories of intelligence, are the beliefs that people hold about the nature of intelligence. Some individuals believe that intelligence is a fixed entity that cannot be changed, whereas others think it is malleable and susceptible to growth (Dweck, 2000). Research with a large sample of secondary school pupils showed that the former, an entity theory of intelligence, also referred to as fixed mindset (Haimovitz & Dweck, 2017), was associated with negative emotions in school, such as anxiety, anger, shame, boredom and hopelessness (King et al., 2012). On the other hand, positive emotions such as enjoyment, hope and pride were not predicted by entity beliefs. Furthermore, fixed mindsets have been found to be associated with maladaptive perfectionism, with a focus on evaluation (Hewitt & Flett, 1991; Shih, 2011). Conversely, an incremental theory of intelligence, also referred to as growth mindset (Haimovitz & Dweck, 2017), was associated with adaptive perfectionism, characterised by positive striving for achievement (Shih, 2011).

Researchers such as Dweck and Leggett (1988) have argued that mindsets form a framework in which individuals attribute meaning to their experience and this results in the pursuit of different types of goals. More precisely, they proposed that people with a fixed mindset tend to pursue performance goals, through which they can evidence their ability and achieve positive praise or avoid criticism. In contrast, people with a growth mindset tend to pursue learning goals to increase their ability. Grant and Dweck (2003) found that the pursuit of learning goals was associated with higher levels of intrinsic motivation, especially when encountering challenges. They argued that those who favour learning goals may see setbacks as information about how to learn and improve, whereas those who endorse performance goals may see failures as evidence of low ability.

A further possibility is that pupils' academic emotions may not be influenced solely by their own mindset. Reich and Arkin (2006) found that undergraduate students were able to perceive the mindset of a test administrator, which influenced their levels of self-doubt. Interestingly, this influence was moderated by performance expectations before the test: students who had low self-expectations expressed more doubt when they thought that the test administrator had a fixed mindset, whereas the opposite was true for students

who expected to perform well. Although the participants in this study were undergraduates, it nevertheless raises the possibility that all learners (e.g., secondary school pupils) form impressions of the mindset of their teachers.

In contrast, Haimovitz and Dweck (2016) found that children were not able to accurately perceive their parents' implicit beliefs about intelligence. Instead, children were able to detect implicit parental beliefs about failure. It was also these beliefs that influenced their subsequent mindsets: parents who believed that failure was debilitating were significantly more likely to have children who reported a fixed mindset. Interestingly, this association was mediated by how children perceived their parents' goals. Children tended to focus on performance, not learning, if they perceived that their parents viewed failure as debilitating.

The present study

Research has shown that teachers often report a growth mindset (see, for example, Jones et al., 2012; Jonsson et al., 2012). Despite this evidence, further studies have found that teachers may not adopt this growth mindset consistently in their teaching practice (Tiekstra & Minnaert, 2017). Consequently, what pupils experience in the classroom is not necessarily an accurate reflection of what teachers report as their implicit beliefs.

This study investigated teachers' implicit beliefs about intelligence and failure, in teaching and learning in maths, as well as pupils' experience of teacher practice in the classroom. It explored the importance of both factors on pupils' mindsets in relation to maths and their levels of maths anxiety. Because previous research has shown that maths anxiety in childhood and adolescence is positively linked to maths anxiety in parents (Maloney et al., 2015), is more common in girls (vs. boys) (Devine et al., 2012), increases with age (Dowker et al., 2016) and is negatively associated with achievement (Maloney et al., 2015; Wu et al., 2012), we measured these factors, to control for their effect on the associations between pupil mindset, teacher mindset and maths anxiety in school. Parental implicit beliefs about intelligence and failure were also assessed to investigate the possibility of a socialisation route for these beliefs that emerges within the family unit (Haimovitz & Dweck, 2016). In addition, reports of pupils' experiences of their parents' goals were obtained to ascertain if teachers' beliefs and practices were influential in the maths domain over and above parental beliefs and practices.

This study aims to replicate and extend the research by King et al. (2012), to consider links between implicit theory of intelligence, and, in addition, implicit theory of failure, as a factor influencing maths anxiety. Furthermore, this study replicates and extends the study by Haimovitz and Dweck (2016), by looking at both parents' and teachers' mindsets, as well as how pupils perceive their parents' and their teachers' teaching and learning goals.

The study aimed to test the following three hypotheses:

1. Pupils who reported that intelligence is a fixed entity and that failure is debilitating would experience higher levels of maths anxiety.
2. Pupils' mindsets with regards to maths (as measured by their beliefs about intelligence and failure) would be associated with their maths teacher's beliefs about failure, i.e. teachers who reported that failure is debilitating would have more pupils with a fixed mindset with regards to maths.
3. The relationship between teachers' failure mindset and pupils' maths mindsets would be mediated by teachers' goal orientation, i.e. pupils would perceive teachers with a failure-is-debilitating mindset to focus on maths performance.

2.2 Method

2.2.1 Participants

Participants included school pupils from Years 7, 8 and 9 (aged 11-14 years) of a large secondary school in the south of England, together with their parents and their maths teachers. One thousand and fifty-four pupils were invited to take part in the study; eight parents opted their child out of the study. As 890 pupils completed all online surveys, this meant a pupil response rate of 86%. In order to check that pupils had taken sufficient time to consider their responses, the completion time was recorded and analysed alongside responses to the questionnaires. Details of this analysis are provided below, to facilitate replicability of our approach.

The data from two pupils were eliminated because they completed all questionnaires in less than two minutes and there was no variation in their responses. Of the remaining 888 pupils, the mean time in seconds for completing the questionnaires was 787.76 seconds (SD= 315.27, R=149-2645). The data of a further 29 pupils were removed because they completed the surveys in a time

two standard deviations below total mean time (*n*=3), or they missed out one of the questionnaires (*n*=4). All data for pupils who completed the surveys in less than ten minutes were examined and removed if they showed little variation in responses across questionnaire items (*n*=22). Of the remaining 859 pupils, 285 were from Year 7, 264 from Year 8 and 310 from Year 9. Considering completion times between year groups, analysis highlighted that pupils in year 9 (*M*= 688.28, *SD*=239.37, *R*=1818) completed the questionnaires faster than those in years 8 (*M*=826.10, *SD*=346.94, *R*=2442) and 7 (*M*=826.29, *SD*=328.30, *R*=2372). Of all participating pupils, 406 identified female, 408 as male and 45 chose not to disclose their gender.

The school taught pupils in 8 attainment sets for maths, from 1 (higher) to 8 (lower) (set 1 *n*=187, set *2* n=185, set 3 *n*=188, set 4 *n*=129, set 5 *n*=75, set 6 *n*= 68, set 7 *n*=38 and set 8 *n*=4). A two-way independent ANOVA showed that there was a significant main effect of maths set on maths anxiety ($F(7,853)=6.35$, $p<.001$, $\eta^2_p=.05$). There was an overall trend of an increase in levels of maths anxiety in lower math sets. Bonferroni post hoc tests showed a statistically significant difference between set one (*M*=52.18, *SD*=16.57) and set five (*M*=61.05, *SD*=21.07; *p*=.03) and lower sets; all other comparisons with set one were non-significant. Based on this, the sets were divided into two groups, higher (sets one to four) and lower (sets five to eight) attainment, for the purpose of further analyses. Further analysis highlighted that pupils in the higher set group reported fewer symptoms of maths anxiety (*M*=55.67, *SD*=18.92) compared with those in the lower group (*M*=63.91, *SD*=21.82; $t(265.279)= 467$, $p<.001$).

Ninety-five parents completed all surveys, which meant a response rate of 9%; after matching parent and pupil data this resulted in the inclusion of data from 84 parents (female *n*=76, male *n*=7, gender not disclosed *n*=1). Further explorative independent-samples t-tests showed that pupils whose parents had not taken part reported higher levels of anxiety (*M*=57.86, *SD*=20.09) than the pupils whose parents did take part (*M*=53.12, *SD*=16.95; $t(857)=2.08$, $p=.04$). There were no significant differences at pupil level for any other dependent variables between pupils with participating or non-participating parents, $ts(857)<.50$, $p>.05$. There was no significant association between parent participation and the set level of their child's maths class, $\chi^2(1) =2.81$, $p=.09$; based on the odds ratio, the odds of a parent of a child in a higher set taking part were 1.1 times higher than a parent of a child in a lower set taking part.

Nine teachers out of 17 completed all surveys (female *n*=6, male *n*=3; response rate 53%). Further exploration showed that pupils whose maths teacher had taken part reported significantly higher levels of maths anxiety (*M*=59.37, *SD*=20.44) than those whose teacher did not (*M*=54.79, *SD*=18.75; *t*(857)=3.36, *p*=.001). This was influenced by the significant association between the set level, either high or low, and teacher participation, $\chi^2(1) = 20.98$, $p<.001$; based on the odds ratio, the odds of a teacher of a low set taking part were 2.26 times higher than a teacher of a high set taking part. There were no significant differences for any other dependent variables between pupils with participating or non-participating teachers, *ts*(857)<1.20, *p*>.05.

2.2.2 Design and Measures

The study used correlation and regression analyses to consider the direct association between pupils' maths mindsets, as reflected by their implicit theories of intelligence, as well as failure, and maths anxiety. A hierarchical regression was conducted to establish whether or not parental beliefs and maths anxiety made a significant contribution to pupils' maths anxiety, over and above their own beliefs and their perception of their parents' and maths teachers' goals. The same analysis was also used to consider whether or not teachers' implicit beliefs about intelligence and failure were predictive of pupils' maths mindsets.

Implicit Theory of Intelligence

I measured growth mindsets of all participant groups, using a three-item implicit theories of intelligence questionnaire. The reliability of the scale is reported as good, αs >.90 (Dweck et al., 1995). The questionnaire was adapted to include the word maths (e.g., "You have a certain amount of mathematical intelligence and you really can't do much to change it"). Participants rated the degree to which they agreed with each item, from 1 (strongly agree) to 6 (strongly disagree; score range 3-18). Higher scores indicated a growth mindset. In the current study αs >.7 for all groups.

Implicit Theory of Failure

I measured beliefs about failure of all participant groups, using a six-item implicit theories of failure questionnaire, α=.88 (Haimovitz & Dweck, 2016), adapted to include the word maths (e.g., "The effects of failure in maths are positive and should be utilised"). Participants rated the degree to which they agreed with each item from 1 (strongly agree) to 6 (strongly disagree; score range

6-36). Higher scores indicated perceptions that failure is beneficial to learning. In the current study, the reliability for this scale was acceptable (αs>.7 for Year 8 and 9 pupils, teachers and parents), but questionable for Year 7 pupils (α=.59). We tried to take out items from the questionnaire for this age group, but it did not greatly increase reliability, so the entire questionnaire was taken into account for analysis.

Perception of parental goals

Pupils' perceptions of their parents' goals were assessed using an 11-item questionnaire, where six items assess mastery orientation (α=.65) and five items assess performance orientation (α=.70) (Friedel, Cortina, Turner, & Midgley, 2007). Pupils indicated agreement from 1 (strongly agree) to 6 (strongly disagree; score range =6-66). All 11 items generated one score: higher scores indicated that they perceived their parents' goals to be orientated towards learning (versus achievement). In the current study αs>.7 for all year groups.

Perception of teacher goals

Pupils' perceptions of their maths teacher's goals were assessed using a 10-item questionnaire, where five items assess teacher mastery orientation, α=.74, and five items assess teacher performance orientation, α=.84 (Friedel et al., 2007). Pupils indicated agreement from 1 (strongly agree) to 6 (strongly disagree). All 10 items generated one score: higher scores indicated perceptions of teacher's goals oriented towards learning (versus performance oriented). In the current study αs>.7 for all year groups.

Maths anxiety

Pupils', parents' and teachers' levels of maths anxiety were assessed using the Shorter Maths Anxiety Rating Scale (MARS; Alexander & Martray, 1989), which contains 25 items. Americanisms were changed to terms consistent to UK English (e.g., "grade" to "mark", "pop quiz" to "fun quiz"). Participants rated their agreement on a scale from 1 (not at all anxious) to 5 (very anxious). Score range = 25-125, with higher scores reflecting higher levels of maths anxiety. Reliability in this study αs>.7 for all participant groups.

2.2.3 Ethical considerations

Ethical approval for this study was given by Research Governance and the Ethics Committee at the University of Southampton (see Appendix F). The researcher approached a head teacher of a large secondary school in the South of England,

explained the study in a face-to-face meeting and gave the opportunity to ask questions (see Appendix G). Once the head teacher had given consent for the study to take place in the school (Appendix H), the head teacher was asked to distribute an email to the parents of all pupils in years 7,8 and 9 (Appendix I), as well as all maths teachers (Appendix J), with an attached letter detailing the research. Parents were given the opportunity to opt their child out of the study if they did not consent him or her to take part (n=8). Apart from this, opt-in consent was used for all participants at the time of participation (Appendix K). The pupils were asked to complete the questionnaire in one of their lessons during normal school hours; they were reminded that they were under no obligation to take part. Parents and teachers completed the questionnaires at a time of their convenience. The researcher remained blind to participant identity across all three participant groups. Participants were told that they could withdraw from the study at any point. They were shown a debrief page after their participation and they were given the researcher's contact details should they wish to have a further discussion at a later date (Appendix L).

2.2.4 Procedure

All pupils, whose parents had not opted them out of the study, were given a link to the online study during an IT lesson. They read brief details that outlined the aims of the research before giving informed assent. All pupils were asked to provide demographic information related to gender and ethnicity (see Appendix N). The maths mindsets of all participants were measured through the administration of two questionnaires, reflecting implicit theories of intelligence and implicit theories of failure. All measures, for pupils, parents and teachers, were taken through five online questionnaires (see pages 111-114). The researcher wrote an introductory statement to each questionnaire, which briefly explained what it was about. The researcher also explained the response options in this introduction and reminded participants that there were no right or wrong answers. Questionnaires were presented in three fixed order blocks: block one on focused implicit theories of intelligence and failure; block two focused on perceptions of their parents' and teachers' goals; and block three focused on maths anxiety. Questionnaires in blocks one and two were counterbalanced between participants. Pupils read a debrief page once the questionnaires had been completed. The procedure for parents and teachers was the same, except that block two was omitted.

2.2.5 Analytical approach

Because pupils were taught in classes by different maths teachers, multilevel linear modelling was considered to evaluate the influence that teachers had on the maths anxiety of pupils in their class. This is an appropriate approach for nested designs because it accounts statistically for the clustering of the data of pupils within one class. The null model was tested to estimate the mean level of pupil maths anxiety across all teachers and to calculate the intraclass correlation (ICC). The null model was non-significant (Wald Z=1.179, p=.24). The ICC was small, suggesting that only 1.4% of the total variability in maths anxiety scores was between teachers. This meant that the development of a multilevel model was not warranted.

To investigate the impact of teachers' implicit theories on pupils' dependent variables, teachers were divided into two groups to reflect their scores on the implicit theory of intelligence the implicit theory of failure questionnaires. Teachers with scores below the mean were placed in group 1 (fixed intelligence mindset, failure-is-debilitating mindset) and teachers with scores above the mean were place in group 2 (growth intelligence mindset, failure-is-beneficial mindset). Independent t-tests showed that the groups differed significantly, both for implicit intelligence theory (M=13.25, SD=2.06; M=16.60, SD=.89; t(3.905)=3.03, p=.04) and for implicit failure theory (M=23.40, SD=1.52; M=28.50, SD=3.00; t(4.220)=3.10, p=.03). These groups were therefore used in the remainder of the analysis. After an exploration of the data, the hypotheses were tested via correlational exploration of the data followed by linear and hierarchical regressions. All regression models were checked for outliers by considering Mahalanobis distances (Field, 2014) and regressions were re-run without cases that exceeded the critical distance.

2.3 Results

2.3.1 Descriptive statistics of pupil data

The data set of the pupils showed 27 missing data points (0.06% of the total data set) across the different scales; these were replaced by the mean value of the scale. There were no missing data for parents or teachers. The means and standard deviation of pupils' responses to the dependent measures, by year group and gender, can be found in Table 4 (a, b, c and d).

Table 4a. Means and standard deviations of dependent measures of Year 7 pupils

	Year 7								
	Female		Male		Did not disclose gender		Total (*n*=285)		
Pupil Report	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Range
Theory of Intelligence	12.92	3.47	11.63	3.49	12.18	4.42	12.29	3.56	4–18
Theory of Failure	24.49	4.14	23.81	4.27	21.27	5.62	24.05	4.29	11–36
Perception of Parents'	49.25	7.42	46.19	6.61	47.18	5.49	47.73	7.12	21–66
Perception of Teacher's Goals	44.93	8.29	43.22	6.13	44.82	9.12	44.12	7.40	15–60
Maths Anxiety	60.46	22.25	55.05	17.68	52.73	20.96	57.62	20.30	25–125

Table 4b. Means and standard deviations of dependent measures of Year 8 pupils

	Year 8								
	Female		Male		Did not disclose gender		Total (*n*=264)		
Pupil Report	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Range
Theory of Intelligence	12.34	3.64	12.54	3.43	10.27	4.84	12.34	3.61	3–18
Theory of Failure	23.45	4.94	24.26	4.63	22.95	5.84	23.80	4.84	6–36
Perception of Parents' Goals	49.45	7.25	47.29	7.48	47.09	5.63	48.34	7.36	26–64
Perception of Teacher's Goals	44.43	9.24	42.83	8.19	39.82	10.55	43.49	8.86	13–60
Maths Anxiety	60.39	20.47	53.57	19.98	46.00	18.93	56.61	20.50	25–125

Table 4c. Means and standard deviations of dependent measures of Year 9 pupils

	Year 9								
	Female		Male		Did not disclose gender		Total (*n*=310)		
Pupil Report	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Range
Theory of Intelligence	12.86	3.25	12.60	3.42	12.87	3.77	12.73	3.36	3–18
Theory of Failure	23.82	4.10	23.94	4.90	23.00	4.58	23.82	4.53	8–35
Perception of Parents' Goals	48.79	7.17	46.11	6.97	42.91	7.84	47.05	7.31	22–66
Perception of Teacher's Goals	43.05	7.17	41.85	8.06	39.57	7.87	42.21	7.70	15–60
Maths Anxiety	60.50	18.46	55.87	18.95	55.35	19.80	57.86	18.88	25–118

Table 4d. Means and standard deviations of dependent measures of all pupils

	All Year groups								
	Female		Male		Did not disclose gender		Total (*n*=859)		
Pupil Report	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	Range
Theory of Intelligence	12.71	3.46	12.26	3.46	12.06	4.24	12.47	3.51	3–18
Theory of Failure	23.93	4.41	23.99	4.61	22.56	5.10	23.89	4.55	6–36
Perception of Parents' Goals	49.16	7.27	46.49	7.01	44.97	7.03	47.67	7.27	21–66
Perception of Teacher's Goals	44.14	8.28	42.60	7.53	40.91	8.96	43.24	8.01	13–60
Maths Anxiety	60.50	18.46	55.87	18.95	55.35	19.80	57.40	19.85	25–125

2.3.1.1 Exploration of effects of pupil gender and year group on dependent measures

A series of two-way independent univariate analyses of variance (ANOVA) were conducted to examine the effects of year group (Year 7, 8 and 9) and gender (female, male and gender not disclosed) on pupils' responses to each dependent measure. This preliminary analysis revealed that there were no significant main effects of gender and year group on theory of intelligence (in all cases Fs<2.59, ps>.05). There was, however, an interaction effect of gender and year group that was not quite statistically significant and had a small effect (F(4, 858)=2.38, p=.05, η^2_p=.01).

There were no significant main effects, nor any significant interaction effects, of gender and year group on theory of failure (in all cases *F*s<2.26, *p*s>.1). Analysis indicated a significant main effect of gender on pupils' perception of their parents' goals (*F*(2,858)=15.44, *p*<.001, η^2_p=.04). Bonferroni post hoc tests showed that girls perceived their parents to be more oriented towards learning, as opposed to both boys and those who did not disclose their gender. The difference between boys and those who did not disclose their gender was non-significant. The main effect of year group and the interaction between year group and gender were not significant (*F*s<2.67, *p*s>.05).

For perception of maths teacher goals, there were main effects for both gender (*F*(2,858)=4.80, *p*=.01, η^2_p=.01) and year group (*F*(2,858)=3.51, *p*=.03, η^2_p=.003). Post hoc analysis showed that girls, compared with boys and those who did not disclose their gender, perceived their teacher to be more oriented towards learning. There was no statistical difference between boys and those who did not disclose gender. Considering age group, Bonferroni post hoc tests showed that pupils in Year 7 considered teachers to be more oriented towards learning compared with those in Year 9. The difference between Years 7 and 8 and the difference between Years 8 and 9 was non-significant. The interaction between gender and year group was non-significant (*F*<1, *p*>.1).

For maths anxiety, the preliminary analysis revealed a significant effect of gender (*F*(2,858)=10.19, *p*<.001, η^2_p=.02). Bonferroni post hoc tests showed that reported maths anxiety was significantly higher in girls than in boys (*p*<.001) and in those who did not disclose gender (*p*=.03). The difference between boys and those who did not disclose gender was non-significant. The main effect of year group and the interaction between gender and year group were not significant (*F*s<1.09, *p*s>.1). (see Table 4 a, b, c and d).

2.3.1.2 Associations between pupil responses

Considering associations between pupil responses, Table 5 shows that if pupils reported increased levels of maths anxiety, they also reported beliefs aligned with a fixed mindset and a debilitating view of failure. Furthermore, increased maths anxiety was associated with increased perceptions of parental and teacher goals as performance oriented (vs. oriented towards learning). Further analysis considering associations with pupil variables and maths set showed an association with maths anxiety. In addition, pupils in the higher sets (vs. lower sets) reported higher scores for theory of intelligence, indicating they tended

more towards a growth mindset ($t(852)= 3.69$, $p<001$) and higher scores for theory of failure, indicating they tended more towards a view that failure is beneficial for learning ($t(852)= 4.21$, $p<.001$). They also reported that they perceived their teacher's goals more oriented towards learning ($t(852)= 2.79$, $p=.005$) than the pupils in the lower sets. There was no statistically significant difference between pupils in higher or lower sets with regards to how they perceived their parents' goals ($t(852)= .312$, $p=ns$).

Table 5. Means, standard deviations and correlations of parent and pupil data

	M	*SD*	Range	1	2	3	4	5	6	7	8	9	10	11	12
Parent reports [a]															
1.Theory of intelligence	13.85	2.85	6–18	–											
2.Theory of failure	21.59	7.10	6–38	.07	–										
3.Maths Anxiety	53.68	20.10	25–100	–.31**	–.23*	–									
Teacher reports [a]															
4.Theory of intelligence (high or low)	–	–		–	–	–	–								
5.Theory of failure (high or low)	–	–		–	–	–	.49**								
Pupil reports [a]															
6.Theory of intelligence	12.46	3.51	3–18	.04	.00	.02	–.05	.01	–						
7.Theory of failure	23.89	4.55	6–36	–.25*	.01	–.13	–.04	.08	.24**	–					
8.Perception of parents' goals	47.67	7.27	21–66	.12	.09	.01	–.02	.01	.20**	.32**	–				
9.Perception of maths teacher's goals	43.24	8.01	13–60	–.02	.03	.08	–.10*	.14**	.20**	.29**	.34**	–			
10.Maths Anxiety	57.40	19.85	25–125	.11	–.16	.23*	–.01	.04	–.07*	–.17**	–.10**	–.11**	–		
Other factors [b]															
11. Maths set	–	–		.08	–.07	.27*	.13**	–.07	–.18**	–.18**	–.04	–.12**	.19**		
12. Gender	–	–		–.14	.05	–.03	.04	.03	–.07*	–.04	–.22**	–.13**	–.14**	–.06	–

Note: *p<.05, **p<.001. All correlations with parents N=84, with teachers N= 491 and those within pupils N=859 [a]=Pearson's r, [b]=Spearman's Rho

2.3.1.3 Descriptive statistics of parent data and associations between responses to the dependent measures

The mean and standard deviations of the parents' responses on the dependent measures can be seen in Table 5 (for Spearman's rho correlations see Appendix M). Bivariate correlations in this table show that if a parent reported a fixed mindset and a belief that failure is debilitating for learning, as reflected in lower scores on both the theory and intelligence and failure questionnaires, they also reported higher maths anxiety. Parent theories of intelligence and failure were not associated.

2.3.1.4 Associations between pupil and parent responses

Table 5 shows that parents' levels of maths anxiety were positively correlated with higher maths anxiety in pupils. Also, there was a negative correlation between pupils' theories of failure and parent theory of intelligence, indicating that parents' beliefs that intelligence is fixed were correlated with pupils' belief that failure is beneficial.

2.3.1.5 Descriptive statistics of teacher data and associations between responses to the dependent measures

The mean, standard deviation and bivariate correlations for the teachers' responses on the dependent measures can be found in Table 6.

Table 6. Mean, standard deviation and Spearman's correlation coefficients of teachers' responses (N=9)

Teacher reports	*M*	*SD*	Range	1	2	3
1. Theory of intelligence	15.11	2.26	11–18	–		
2. Theory of failure	25.67	3.43	21–32	.12	–	
3. Maths Anxiety	45.44	13.08	28–69	.40	–.24	–

Table 6 shows that there were no significant correlations between teacher variables.

2.3.1.6 Pupils' mindsets and maths anxiety

To investigate the relationship between pupil mindset and maths anxiety, we used regression analyses, using the enter method, with pupils' maths anxiety as the dependent variable and pupils' theories of intelligence and failure as predictors. The Mahalanobis distance exceeded the critical value of 13.82 and

therefore three outliers were removed from this analysis. The regression model overall was significant ($F(855)=10.99$, $p<.001$). Analysis of the regression coefficients showed that pupils' implicit theory of failure was a significant predictor of maths anxiety (accounting for about 2.3 per cent of variance), whereas implicit theory of intelligence was not (see Table 7).

Table 7. Summary of linear regression of implicit theories of intelligence and failure on pupils' maths anxiety (N=856)

Variable	*B*	*SE B*	β	*t*	*p*
Pupils' theory of intelligence	-.22	.20	-.04	1.13	.26
Pupils' theory of failure	.65	.16	-.15	4.16	<.001

Note: R^2=.023

Because several other pupil variables were associated with pupil maths anxiety, these were included the regression analysis to control for their effect on maths anxiety. The enter method was used, with pupil maths anxiety as the dependent variable and pupils' theory of intelligence, theory of failure, perception of their parents' goals, perception of their teacher's goals, pupils' gender and maths set as predictor variables. This showed that there were six outliers (Mahalanobis distance >22.46) and these were removed from this analysis. The regression model was significant ($F(847)=11.60$, $p<.001$). It showed that, in addition to pupils' theory of failure as a significant predictor of maths anxiety, several other factors were also linked, including pupils' perception of their parents' goals, pupils' gender and maths set (Table 8). Implicit theory of failure was therefore carried forward in subsequent analyses as a significant indicator of pupils' maths mindsets, whereas implicit theory of intelligence was no longer taken into consideration.

Table 8. Summary of linear regression of pupil reported variables on maths anxiety (*N*=848)

Variable	*B*	*SE B*	β	*t*	*p*
Pupils' theory of intelligence	-.12	.20	-.02	.63	.53
Pupils' theory of failure	-.39	.16	-.09	2.40	.02
Perception of parents' goals	-.24	.10	-.09	2.32	.02
Perception of maths teachers' goals	-.12	.09	-.05	1.31	.19
Maths set (high or low)	7.10	1.63	-.15	4.37	<.001
Gender	-5.47	1.15	.16	4.77	<.001

R^2=.07

2.3.1.7 Associations between pupils' maths anxiety and parent factors

To explore if parent variables made a significant contribution to maths anxiety, over and above the other pupil variables, we used hierarchical regression (block-wise entry; N=83 vs. N=848 in the above analysis). Parent implicit theory of intelligence, parent implicit theory of failure and parent maths anxiety were entered in the first block and the ANOVA was significant ($F(82)=2.95$, $p=.04$). Pupil variables were entered in the second block and the ANOVA remained significant ($F(82)=2.47$, $p=.02$).

This analysis showed that only parent maths anxiety was associated with pupil maths anxiety (and not parent mindset), accounting for 10 per cent of the variance. In this analysis, when pupil variables were entered into the next step, parent maths anxiety was marginally significant ($p=.08$) and only gender remained a significant predictor of maths anxiety (see Table 9). Step 2 accounted for about 23 per cent of the variance in maths anxiety and the r-squared change approached significance ($\Delta R^2=.13$, $p=.06$).

Table 9. Summary of hierarchical regressions predicting pupil maths anxiety (*N*=83)

Variable	*B*	*SE B*	β	*t*	*p*
Step 1					
Parent theory of intelligence	1.16	.70	.19	1.67	.10
Parent theory of failure	-.30	.27	-.12	1.11	.27
Parent maths anxiety	.23	.10	.26	2.30	.02
Step 2					
Parent theory of intelligence	.84	.74	.14	1.13	.26
Parent theory of failure	-.26	.26	-.10	.97	.33
Parent maths anxiety	.18	.10	.21	1.76	.08
Pupil theory of intelligence	-1.00	.59	-.18	1.69	.10
Pupil theory of failure	-.05	.49	-.01	.10	.92
Perception of parents' goals	-.10	.34	-.04	.29	.78
Perception of maths teachers' goals	-.12	.27	-.05	.44	.66
Maths set (high or low)	5.94	5.66	.12	1.05	.30
Gender	-9.68	3.27	-.34	2.97	.004

Note: R^2=.10 for Step 1, *p*=.04; ΔR^2=.13 for Step 2, *p*=.06

2.3.1.8 Associations between pupils' maths mindsets and teacher beliefs

Two linear regression analyses were conducted, with pupils' theory of failure as the dependent variable and teachers' theories of intelligence and failure (high or low) as the predictors. The enter method was used. Considering the first regression, the model was significant ($F(489)=3.43$, $p=.03$), with both variables accounting for about 1 per cent of the variance. The regression coefficients showed that teachers' implicit theory of failure was a significant predictor of pupils' implicit theory of failure and teachers' implicit theory of intelligence was marginally significant (see Table 10).

Table 10. Summary of linear regression of teachers' theories of intelligence and failure on pupils' theory of failure (*N*=490)

Variable	*B*	*SE B*	β	*t*	*p*
Teachers' theory of intelligence	-.90	.46	-.10	-1.95	.05
Teachers' theory of failure	1.19	.48	.13*	2.48	.01

R^2=.010

To control for other variables associated with pupils' failure theory, the regression was run again with pupils' implicit theory of intelligence, pupils' perception of parents' goals and maths set in the first block (F(488)=31.93, p<.001) and teachers' implicit theories of intelligence and failure in the second block (F(488)=19.98, p<.001). Inspection of the regression coefficients showed that teachers' implicit theory of failure remained only marginally significant (see Table 11).

Table 11. Summary of hierarchical regression predicting pupils' implicit theory of failure

Variable	*B*	*SE B*	β	*t*	*p*
Step 1					
Pupils' theory of intelligence	.28	.05	.22**	5.05	<.001
Perception of parents' goals	.16	.03	.26**	6.16	<.001
Maths set high or low	-1.53	.42	-.15**	3.61	<.001
Step 2					
Pupils' theory of intelligence	.27	.05	.21**	5.01	<.001
Perception of parents' goals	.16	.03	.26**	6.16	<.001
Maths set high or low	-1.45	.43	-.15*	3.39	<.001
Teachers' theory of intelligence	.43	.43	-.05	.99	.32
Teachers' theory of failure	.87	.45	.09	1.94	.05

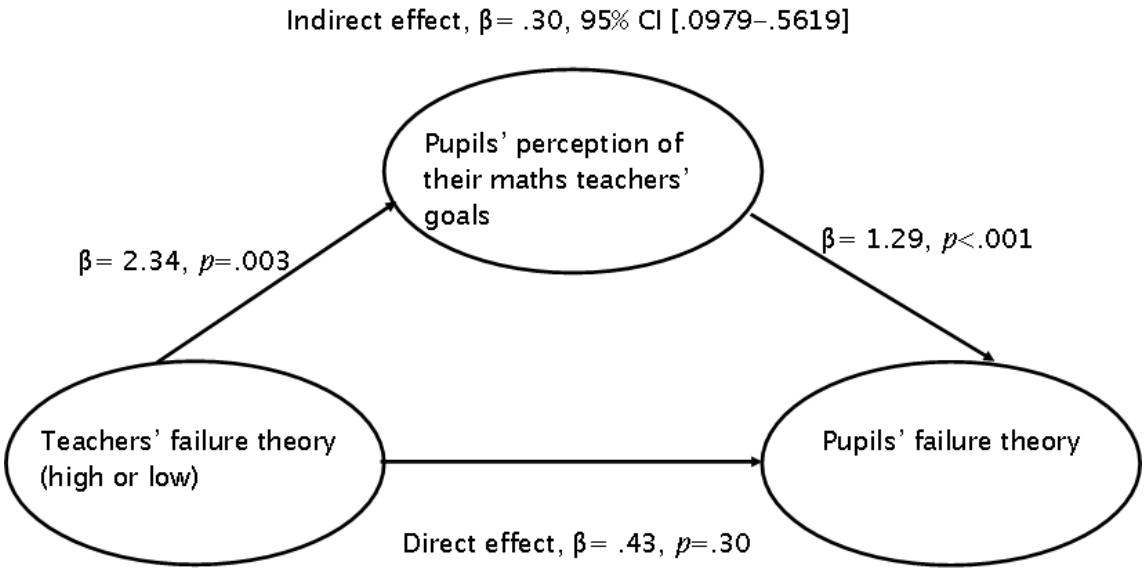
Note: R^2=.17, p<.001 for Step 1; ΔR^2=.01, p=.15 for Step 2

2.3.1.9 Exploring pupils' perceptions of maths teachers' goals as indirectly influencing the association between teacher and pupil theory of failure

As teachers' implicit theory of failure, after controlling for other associated variables, was a marginally significant predictor for pupils' implicit theory of failure, a mediation analysis was run, using a bootstrapping procedure with 1000 bootstrap samples and bias-corrected (BC) 95% confidence intervals (CI), as suggested by (Hayes, Preacher, & Hayes, 2008), to explore direct effects between teacher failure theory and pupil failure theory, and indirect effects via pupil perception of teacher goals.

The model showed that, whilst the total effect of teachers' implicit theory of failure on pupils' implicit theory of failure was non-significant (β=.73 *p*=.08), including the indirect effect of pupils' perception of their teachers' goals had a significant influence on this association. The normal theory test for indirect effects showed that this was significant (z=2.6122, *p*=.009) (see Figure 3 3).

Figure 3. Model of the direct and indirect relationships between teachers' and pupils' theory of failure.



2.4 Discussion

2.4.1 Key findings

Maths anxiety has consistently been shown to be negatively associated with achievement in maths (Ma, 1999). As such, it is important to understand the mechanisms of how maths anxiety develops and is sustained. This study investigated the association between pupils' maths mindsets, as conceptualised by their implicit beliefs about intelligence and failure, and their levels of maths anxiety. Additionally, it investigated whether or not teachers' implicit beliefs about intelligence and failure were associated with pupils' maths mindsets. Finally, it aimed to explore possible mechanisms for the socialisation of these mindsets, by studying the role that pupils' perceptions of their teachers' goals might have.

Consistent with hypothesis 1, the results showed that pupils who reported that failure is debilitating, also reported more symptoms of maths anxiety (and, conversely, those who indicated that failure is beneficial had fewer symptoms of maths anxiety). In contrast, implicit beliefs about intelligence were not associated with maths anxiety symptoms. The result is in contrast with previous research, which found that pupils with a fixed intelligence mindset experienced higher levels of academic anxiety, as well as anger, shame, boredom and hopelessness at school (King et al., 2012). In addition, the current study showed that implicit beliefs about failure remained significantly associated with pupils' maths anxiety, even when controlling for other factors, such as pupils' perception of their parents' and their teachers' goals, their gender and their maths set. This study has therefore added to existing literature by showing how pupils' beliefs about failure make a unique contribution to maths anxiety, in addition to those made by other factors, such as gender (Devine et al., 2012) and maths achievement (Maloney et al., 2015), as indicated by the proxy measure of maths set.

The results of this study also indicated that neither parents' beliefs about intelligence nor failure were linked to pupils' maths anxiety. Parents' self-reported maths anxiety was associated with maths anxiety in offspring. This finding fits with previous research that has found a similar association. Such research has indicated that this link can be explained through a complex set of interactions that include genetic (Wang et al., 2014) and environmental influences (Maloney et al., 2015). In this study, however, when considering other measured

variables associated with pupil maths anxiety, this relationship was only marginally significant and only pupils' gender remained as a significant predictor.

Participants in this study were given the opportunity to opt out of disclosing their gender and 45 pupils included in the analysis chose to do so. This formed just over five per cent of the total of included pupil participants; this rate was much higher than in a recent study amongst adolescents in the United States, in which 2.7 per cent of participants identified as either transgender or gender-nonconforming (Eisenberg et al., 2017). The high rate of pupils who chose not to disclose information about their gender suggests that, in the current climate of research, it is important to make this option available to participants. In terms of the effect of gender on the pupil dependent variables, it is interesting to note that where there was a significant main effect, those who chose not to disclose their gender were statistically different from girls, but not from boys. For example, in line with previous research, maths anxiety was higher in girls than in boys (Devine et al., 2012), but maths anxiety was also higher in girls than in those who did not disclose their gender.

Considering teacher mindset, this study showed, consistent with hypothesis 2, that teachers' implicit theories of failure were most clearly related to pupils' implicit theories of failure, compared with teachers' implicit beliefs about intelligence (this association was marginally significant). This meant that teachers who were most likely to report failure as debilitating were most likely to have pupils who reported a similar perspective. This finding bears some similarity with the study by Haimovitz and Dweck (2016), who found that parents' failure mindsets were associated with pupils' intelligence mindsets, whereas parents' intelligence mindsets were not. It suggests, as Haimovitz and Dweck propose, that implicit beliefs about failure may be more visible to pupils than implicit beliefs about intelligence and, as a result, more of influence on pupils' own beliefs. In addition, when other variables associated with pupils' theories of failure were controlled for in our analysis, this relationship remained marginally significant (p=.05).

The lack of statistically significant direct relationship between teachers' implicit beliefs about failure and their pupils' implicit failure beliefs may possibly be due to the fact that teachers may find it hard to translate their beliefs into observable practice, especially when these beliefs reflect a view that failure is beneficial for growth. Similarly, research has found that whilst teachers tend to report that they viewed intelligence as malleable, this was not necessarily associated with the use

of mastery goals in the classroom (Deemer, 2000; Matteucci et al., 2017; Shim et al., 2013). Teachers who reported having a fixed mindset, on the other hand, seemed more consistent in putting their beliefs into practice (Tiekstra & Minnaert, 2017). Perhaps a similar discrepancy in continuity of practice, which occurs between fixed or malleable beliefs about intelligence, also exists for beliefs about failure, where teachers are not sufficiently able to communicate a belief that pupils can learn from failure through their actions in the classroom. Nevertheless, this perception of their teachers' goals proved to be influential on pupils' subsequent failure mindsets in this study. Consistent with hypothesis 3, pupils who perceived their teacher to be more oriented towards performance, rather than learning, were more inclined to report a belief that failure was debilitating. This failure mindset, in turn, was predictive of levels of maths anxiety.

It was interesting to observe the relationship between levels of attainment and maths anxiety in this data set. In line with research (Maloney et al., 2015; Wu et al., 2012), maths anxiety was lower in the higher than in the lower attainment sets. Finally, it was also noteworthy that, in contrast with what other research suggests (Dowker et al., 2016), maths anxiety did not increase with age, as indicated by year group. On the other hand, participants in this study were from three different year groups, all of secondary school age, whereas other researchers have considered attitudes to maths in a wider age span; for example, Blatchford (1996) considered pupils between 7 and 16 years of age.

2.4.2 Limitations and directions for future research

This study has several limitations. The study was correlational in its nature and it could not, therefore, reveal causality between variables. Furthermore, measurements were taken at a single time point, which means the study could not provide an insight into the influence of teachers' goals and mindsets on their pupils' academic emotions over time. The timing of the surveys, late in the summer term, was chosen to compensate for this somewhat, as pupils had had lessons from their maths teacher for a prolonged period of time. They were therefore more likely to be able to report accurately on how they had perceived their teacher's goals over the academic year.

Furthermore, in this study the mindsets of participants, with regards to intelligence as well as failure, were assessed through self-reports, a methodology that has its limitations. For example, participants in studies using self-reports may have difficulties interpreting the items of a scale (Karabenick et al., 2007) or

use alternative interpretations to the researchers' intention (Urdan & Mestas, 2006). Also, the conceptualisation of some constructs, such as, for example, performance and mastery goals, are subject to disagreements amongst researchers (Elliot & Murayama, 2008). Finally, many self-report measures lack sufficient reliability (Fulmer & Frijters, 2009). Whilst the measures that were used in this study have been reported as reliable in previous research (Alexander & Martray, 1989; Dweck et al., 1995; Friedel et al., 2007; Haimovitz & Dweck, 2016) -and indeed were shown to be reliable in this data set- they could nevertheless only offer limited insights into the implicit beliefs held by participants. Future research, from an interpretivist, rather than positivist, epistemological position (Grix, 2002) would be a useful addition to the body of research in this area. Such research could facilitate a deeper understanding, for example, of how teachers give meaning to their implicit beliefs about intelligence and failure (see, for example, Calisto, 2014).

Research into the intelligence mindsets of teachers, using correlational designs with questionnaires, has generally found that teachers report a growth mindset (see, for example, Jones et al., 2012; Jonsson et al., 2012). Indeed, also in this study, teachers' scores of their beliefs about intelligence and failure were above the mean, indicating that they subscribed to an incremental view of intelligence, as well as a belief that failure is beneficial to learning. Dweck et al. (1995) alluded to the social desirability or reporting a growth mindset with regards to intelligence; it might also be the case that participants in this study viewed the belief that failure is beneficial as more socially desirable. The social desirability effect could therefore have skewed responses through which existing patterns of associations may have been missed. Research from a different methodological position, for example, using implicit measures of implicit beliefs, instead of questionnaires, could be a very useful way forward (see, for example, Mascret et al., 2015). Not only would it circumvent the issue of social desirability, it would also seem to be in keeping with the notion that these beliefs are implicit and not necessarily available for conscious reporting. Indeed, some interesting findings have already emerged from the use of such measures. For example, science teachers, especially male, were found to show negative implicit associations between lexical stimuli depicting intelligence and malleability, whereas teachers of French language classes and history did not (Mascret et al., 2015).

The participation rate amongst teachers in this study was 53 per cent. Whilst this is in line with other research conducted with teachers in this area (see, for example, Lynott & Woolfolk, 1994; Tiekstra & Minnaert, 2017), it nevertheless

leaves questions as to why the other teachers in the school chose not to take part. The results showed some evidence that participation was not entirely random, but that the participants were of a self-selected sample. Teachers who took part were more likely to have pupils that reported higher levels of maths anxiety than the teachers who did not participate. They were also more likely to teach lower sets. Interestingly, the pattern was reversed for parents: parents who took part had offspring who reported lower levels of maths anxiety than those who did not take part. The response rate from pupils was very high at 86 per cent. However, parent uptake was only nine per cent and this meant we had to work with a much reduced data set for the analyses in which we tried to control for parent variables. As a result, these analyses were underpowered and we could only draw preliminary conclusions from it. Future research should endeavour to collect data from a larger set of parents to enable fully powered analyses of combined data from teachers, pupils and parents. It should also aim to obtain data from all teachers in a particular school to make sure that selective participation based on implicit beliefs does not take place.

Although the response rate amongst pupils was very high, the study was nevertheless conducted in one school only. This means that responses from pupils and teachers are situated within one school culture. Deemer (2000) found a direct relationship between teachers' perceptions of the culture in their school and pupils' perceptions of the goals promoted in class. However, she did not find a direct relationship between teachers' intelligence mindsets and pupils' goal perception. This suggests that how pupils perceive their teachers' goals may be influenced by factors beyond the beliefs of individual teachers. Future research, in other school contexts, is therefore needed to further understand the contribution that beliefs about intelligence and failure, held by individual teachers, make to pupils' academic emotions such as maths anxiety.

2.5 Conclusions and implications for educational practice

This study has brought up some interesting findings that have direct implications for practice in the classroom. It highlighted that pupils who believed that failure is debilitating experienced higher levels of maths anxiety than those who believed that failure is beneficial for learning. Implicit theories of intelligence, or growth and fixed mindsets, have become very salient within education and many pupils will have either read or heard quotes about the benefits of having a growth mindset (Bloom, 2017). However, the results of this study imply that to reduce

pupils' maths anxiety, it may be more beneficial to focus on what pupils believe about failure instead. Teachers should discuss disappointing results with their pupils, as they occur, and show them exactly how they can learn from mistakes and what they need to do to improve on their performance. This will teach pupils that failure may be inevitable at times, can be a helpful part of learning and does not need to be a debilitating experience in the long run.

In this study, teachers' failure mindsets were found to be more influential than teachers' intelligence mindsets on what their pupils believed about failure. This implies that it is helpful for teachers to reflect on what their beliefs about failure are, as well as to reflect on how they can best help their pupils to bounce back after a failure event. Educational psychologists (EPs) are part of a reflective profession and are well placed to support teachers in this process, either through delivering training or, when the occasion arises, in work with individual pupils. EPs can also help teachers to reflect on how they can translate their own helpful beliefs about failure into practical goals that are evident to their pupils in the classroom. This is important, as this study has shown that pupils' perception of their teachers' goals influences their failure mindsets. Specifically, pupils who perceive their teacher to be someone who focuses on performance, rather than learning, are more likely to believe that failure is debilitating. This, in turn, increases their levels of maths anxiety.

This study has illustrated that some groups of pupils may be more prone to experience high levels of maths anxiety. Pupils in lower attainment sets and girls were more like to experience maths anxiety than pupils in higher sets and boys. Of course, some pupils fit both categories and this study therefore implies that it is especially important, for example, to support girls in lower sets, who may experience very high levels of maths anxiety. Teachers, once aware of these patterns, can give these pupils additional support by being mindful of how they portray their goals to their pupils and by helping them to develop ways of seeing failure as a beneficial part of learning, rather than as a debilitating event.

This study has shown the complexity of the development of pupils' implicit beliefs. In practice, it is important for professionals working in education, teachers and EPs alike, to be aware of this complexity, as unhelpful beliefs are unlikely to be remedied by quick remarks or by colourful posters on a classroom wall. Regardless of this complexity, the way in which pupils perceive their teachers' goals has been shown to influence what they believe about failure. Teachers who reflect on their own beliefs, as well as on how they can make

helpful beliefs visible in the classroom, may be better able to support their pupils in seeing a failure event as something from which they can learn and grow. This, in turn, may help these pupils to feel less anxious about maths.

Appendix A Review Protocol

1. Background

Dweck and Leggett (1988) conceptualised a model that could help to explain mastery-orientated and helpless patterns of behaviour, based on research with pupils in education. This model makes a distinction between an entity theory of intelligence, which holds that our ability is a fixed entity, and an incremental theory of intelligence, which stipulates that our ability is malleable and can therefore increase. These implicit theories of intelligence, or mindsets, have been the topic of an increasing body of research, however, the mindsets of teachers and their impact on practices in the classroom have received much less attention (Aus et al., 2017). This review aims to synthesize the available research on this topic to date.

2. The question for this review is: 'What do we know about teachers' implicit theories of intelligence and the impact of these on pedagogical practices in the classroom?'
3. The review will have the following exclusion/inclusion criteria:

Inclusion	Exclusion
• Written in English • Peer reviewed article • Written after 1988 • Topic is implicit theories of intelligence • Topic is teachers' mindset • Includes a measure of mindset	• Written in another language • Theses, book chapters • Written before 1988 • Topic is other implicit theories • Topic is mindset, but not teachers' mindset • No measure of mindset included

4. Methods

4.1 Four different databases will be used to identify articles which fit the inclusion and exclusion criteria stipulated above. These databases will be PsychInfo and PsychArticles via EbscoHost, Web of Science and ERIC. The following search terms will be used in all four databases:

Teacher* OR educator* OR tutor* OR (teaching practitioner*) OR (school teacher*) OR instructor* AND mindset* OR (implicit theor*) OR (theor* of

intelligence) OR (growth mindset*) OR (incremental theor*) OR (malleable trait*) OR (fixed mindset*) OR (entity theor*) OR (static trait*) OR (fixed trait*) OR (intelligence theor*) AND (pedagogical practice*) OR (teaching practice*) OR practice* OR pedagogy OR (goal setting) OR (goal structure*) OR feedback OR praise OR criticism OR (learning goal*) OR (learning goal* orientation) OR (performance goal*) OR (performance goal* orientation) OR (mastery orientation) OR (mastery pattern) OR (ego motivated goal*) OR (mastery goal*) OR (task goal*) OR (competitive goal*) OR (goal directedness) OR (goal direction) OR (outcome goal*) OR (normative goal*) OR objective* OR aim* OR target* OR teaching OR (academic target*) OR (teaching strategy*) OR (teaching method*) AND school* OR (secondary school*) OR (middle school*) OR (secondary education) OR KS3 OR (key stage 3) OR (key stage three) OR (high school*) OR math* OR (math* education)

The titles and abstracts of the resulting list of articles will be screened for relevance. Relevant articles will be extracted in full text and further reviewed according to the inclusion and exclusion criteria.

4.2 The articles that fulfil the inclusion criteria will be used for this qualitative review. The following data will be extracted from the included articles:

Authors & Date	Aims & Objectives	Participant characteristics	Design/ methods	Findings	Conclusions drawn	Implications	Strengths/ Limitations

4.3 The quality of the included articles will be assessed, using an adapted form of the quality assessment developed by Downs and Black (1998). In all items the word patient was replaced with the word participant. Apart from that, items 1, 2, 3, 5, 6, 7, 9, 10, 16, 18, 20, 25 and 27 remain unchanged, and will be used in their original formulation.
In item 4 the word condition was replaced with measures.
In item 8 the word intervention was replaced with the word study.
In item 11 and 12 the word subject was replaced with participants.
Item 13 was reworded to be: 'Was the educational setting where the study took place representative of the majority of educational settings?'
Item 14, 15, 17, 19, 21, 22, 23, 24 and 26 were deleted.

4.4 The results of the different studies will be synthesized by trying to determine different themes throughout the studies. One area of interest will be the findings with regards to teachers' implicit theories of

intelligence, another will be how these theories impact on different areas of pedagogical practise, such as goal setting, feedback and praise.

4.5 The dissemination of the review will take place through inclusion in a thesis write-up. Furthermore, an educational journal with high impact factor will be sought and approached for publication of the review.

References:

Aus, K., Jogi, A.-L., Poom-Valickis, K., Eisenschmidt, E., & Kikas, E. (2017). Associations of newly qualified teachers' beliefs with classroom management practices and approaches to instruction over one schoolyear. *European Journal of Teacher Education, 40*(1), 28-45. doi:10.1080/02619768.2016.1251897

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-273. doi:10.1037/0033-295X.95.2.256

Appendix B Assessment of methodological quality

Assessment of methodological quality, adapted from Downs and Black (1998)

		Aus et al. (2016)	Chen et al. (2016)	Deemer et al. (2004)	De Kraker et al. (2017)	Jones et al. (2012)	Jonsson et al. (2012)	Leroy et al. (2007)
Reporting	1. Is the hypothesis/aim/objective of the study clearly described?	1	1	1	1	1	0	1
	2. Are the main outcomes to be measured clearly described in the Introduction or Methods section?	1	1	1	1	1	1	1
	3. Are the characteristics of the participants included in the study clearly described ?	1	0	1	1	0	1	0
	4. Are the measures of interest clearly described?	1	1	1	1	1	1	1
	5. Are confounding factors described and considered?	0	1	0	1	1	1	0
	6. Are the main findings of the study clearly described?	1	0	1	0	1	0	0
	7. Does the study provide estimates of the random variability in the data for the main outcomes?	1	1	0	1	1	1	1
	8. Have actual probability values been reported(e.g.0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	1	0	0	1	1	0	0
External validity	9. Were the participants asked to participate in the study representative of the entire population from which they were recruited?	0	0	0	0	1	1	1

Appendix B

	10. Were those participants who were prepared to participate representative of the entire population from which they were recruited?	1	0	0	0	1	0	0
	11. Was the educational setting where the study took place representative of the majority of educational settings?	1	0	1	1	0	1	0
Internal	12. If any of the results of the study were based on “data dredging”, was this made clear?	1	1	1	1	1	1	1
	13. Were the statistical tests used to assess the main outcomes appropriate?	1	1	1	1	1	1	1
	14. Were the main outcome measures used accurate (valid and reliable)?	0	1	1	1	1	1	0
	15. Has the impact of lost participants on the results been considered?	0	1	1	1	1	1	1
power	16. Did the study have sufficient power to detect an important effect, where the probability value for a difference being due to chance is less than 5%?	0	1	0	1	1	1	1
	TOTAL SCORE	11	10	10	13	14	12	9

Assessment of methodological quality, adapted from Downs and Black (1998)

		Lynott & Woolfolk (1994)	Matteuci et al. (2007)	Patterson et al. (2016)	Rattan et al. (2011)	Shim et al. (2013)	Stipek et al. (2001)	Tiekstra & Minnaert (2017)
Reporting	1. Is the hypothesis/aim/objective of the study clearly described?	0	1	1	1	1	1	1
	2. Are the main outcomes to be measured clearly described in the Introduction or Methods section?	1	1	1	1	1	0	1
	3. Are the characteristics of the participants included in the study clearly described ?	1	1	1	0	1	1	1
	4. Are the measures of interest clearly described?	1	1	1	1	1	1	0
	5. Are confounding factors described and considered?	0	1	1	0	0	1	1
	6. Are the main findings of the study clearly described?	0	1	1	1	1	0	1
	7. Does the study provide estimates of the random variability in the data for the main outcomes?	0	1	1	1	1	1	0
	8. Have actual probability values been reported(e.g.0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?	0	0	1	0	0	0	1
External validity	9. Were the participants asked to participate in the study representative of the entire population from which they were recruited?	1	1	0	0	0	0	0
	10. Were those participants who were prepared to participate representative of the entire population from which they were recruited?	1	0	0	0	0	0	0

Appendix B

	11. Was the educational setting where the study took place representative of the majority of educational settings?	1	1	1	0	1	1	1
Internal	12. If any of the results of the study were based on “data dredging”, was this made clear?	1	1	1	1	1	1	1
	13. Were the statistical tests used to assess the main outcomes appropriate?	0	1	1	0	1	1	1
	14. Were the main outcome measures used accurate (valid and reliable)?	0	0	0	0	1	1	0
	15. Has the impact of lost participants on the results been considered?	0	1	0	1	0	1	1
power	16. Did the study have sufficient power to detect an important effect, where the probability value for a difference being due to chance is less than 5%?	1	1	1	0	1	0	0
	TOTAL SCORE	8	13	14	7	11	10	10

Appendix C Weight of evidence table

Weight of evidence (Gough, 2007)

	Aus et al. (2017	Chen et al. (2016)	Deemer et al. (2004)	De Kraker et al. (2017)	Jones et al. (2012)	Jonsson et al. (2012)	Leroy et al. (2007)
Weight of evidence A: quality of execution of study • Results from the adapted Down & Black checklist: >10=high, 8-10= medium, <8=low	High	Medium	Medium	High	High	High	Medium
Weight of evidence B: review specific appropriateness of method • provides details of data collection and analysis • Provide a rationale for this approach	High	High	High	High	High	High	High
Weight of evidence C: review specific focus of study to review question • Dichotomous model of theory of intelligence • focus is on the association between teachers' mindset and a measure of impact on classroom practice	High	Medium	High	High	Medium	Medium	High
Weight of evidence D: the extent to which the study contributes evidence to answering review question • High= high or medium rating on A and B and high on C • Medium= not rated high on all counts and not rated low on C • Low= rated low on C	High	Medium	High	High	Medium	Medium	High

Appendix C

Weight of evidence (Gough, 2007)

	Lynott & Woolfolk (1994)	Matteuci et al. (2007)	Patterson et al. (2016)	Rattan et al. (2011)	Shim et al. (2013)	Stipek et al. (2001)	Tiekstra & Minnaert (2017)
Weight of evidence A: quality of execution of study • Results from the adapted Down & Black checklist: >10=high, 8–10= medium, <8=low	Medium	High	High	Low	High	Medium	Medium
Weight of evidence B: review specific appropriateness of method • provides details of data collection and analysis • Provide a rationale for this approach	High	Medium	High	Low	High	Medium	High
Weight of evidence C: review specific focus of study to review question • Dichotomous model of theory of intelligence • focus is on the association between teachers' mindset and a measure of impact on classroom practice	Medium	High	High	High	High	High	High
Weight of evidence D: the extent to which the study contributes evidence to answering review question • High= high or medium rating on A and B and high on C • Medium= not rated high on all counts and not rated low on C • Low= rated low on C	Medium	High	High	Medium	High	High	High

Appendix D Data extraction table

Authors & Date	Hypotheses	Participant characteristics	Design/methods/measures	Findings	Conclusions drawn	Implications	Strengths/Limitations
Aus, Jõgi, Poom-Valickis, Eisenschmidt & Kikas (2017)	H1. Teachers with an entity view of intelligence are more hesitant and reserved about their professional efficacy. Teachers with an incremental view of intelligence are more confident and positive about the impact of their pedagogical practices. H2. Teachers with lower self-efficacy and with entity beliefs promote performance goals, teachers with higher	118 novice teachers, female (*n*=108) and male (*n*=10). Age (*M*=25.94, *R*= 22-43, *SD* =3.9). Experience: 65% <3 months, 15%> one year. 31 were primary school teachers, 87 were secondary school teachers of different subjects. Schools where participants worked were small	Longitudinal correlation study. Data collection over two years and analysed together. **Scales** Implicit theory of ability: Adapted version of the Nature of Ability Beliefs Questionnaire (Leroy et al., 2007) assessing incremental beliefs of ability (*n*=3, α=.55), entity beliefs (*n*=3, α=.59) and innatist view of ability (*n*=4, α=.74).	Latent profile analysis (LPA) showed that there were two groups of teachers, one optimist (41%), less inclined towards entity (Cohen's *d* =-.2.56) and innatist (*d*=-0.99) views of ability and with higher outcome expectations (*d*=0.86), as opposed to a reserved group (59%). Groups did not differ with	Newly qualified teachers' beliefs about the nature of ability form a unified system with their outcome expectations (self-efficacy). Teachers with fewer entity and innatist views of intelligence tended to feel more efficacious.	Teachers incremental beliefs may be skewed because of social desirability of this view. It may be better to ask teachers only about their entity views. Teacher education should focus on challenging entity and innatist views of ability, as	Sample size was limited, affecting the power in the study. The results are for newly qualified teachers only and may not generalize to all teachers. The reliability of the implicit theory scales was much lower than in other studies such as Leroy et al., 2007. This is not explored at all.

	self-efficacy and incremental beliefs promote mastery goals. H3. Teachers with higher outcome expectations and incremental beliefs are more affectionate towards their students, use less psychological and more behavioural control in classroom management.	and large, urban and rural.	Outcome expectations: Estonian version of Teacher Efficacy Scale (TES; Taimalu et al., 2010). (*n*=3, α=.69) Classroom goals: Patterns of Adaptive Learning Survey (PALS; Midgley et al., 2000), assessing mastery goals (*n*=4, α=.64) and performance goals (*n*=4, α=.64). Classroom Management Practices Questionnaire (Taimalu et al., 2010), measuring affection (*n*=3, α=.61), psychological control (*n*=3, α=.67) and	regards to incremental views (*d*=0.04). H2 and H3 partly supported: There was a medium effect of group membership for affection for students *t*(84)=2.81, *p*=0.06, *d*=0.61 and on promoting mastery goals in the classroom *t*(83)=2.64, *p*=0.10, *d*=0.58. There were no statistically significant differences for psychological and behavioural control and	All teachers, both optimist and reserved, had incremental beliefs about ability as well. Optimistic teachers promote more mastery goals and show more affection. Entity views are not related to promoting performance goals; this in accordance	everyone seems already convinced about the role of effort and motivation. Belief in entity views of intelligence is an obstacle for increasing teacher self-efficacy. Teacher education should focus on cognitive processes to support incremental views in new teachers.	

			behavioural control (*n*=3, α=.69)	promoting performance goals in the classroom.	with Stipek (2001).	Future studies should focus on the possible relationship between entity views and attitudes towards mistakes, relative grading and ability grouping. Conscious reflection on implicit beliefs can be a vehicle for growth for new teachers, since beliefs are not easily changed by reading or research, as pre-existing	

Appendix D

						beliefs filter these out.	
Chen, Fwu, Wei & Wang (2016) *In Frontiers in Psychology, vol. 7.*	1.Teachers' obligation-oriented belief about effort is positively correlated with their affective and behavioural attitudes (favouritism and praise) towards the struggling student. 2.Teachers' improvement-oriented belief is positively correlated with their short-term and long-term expectations of the struggling student. 3.Improvement-orientation is negatively correlated with their short-term and	151 high school teachers, female (*n*=118) and male (*n*=33). Age *M*= 38.18 (*SD*=8.47). 22 participants did not pass the manipulation check, 1 participant had not disclosed gender; these were deleted from the data set	Simulation experiment Participants had to read two vignettes, one of a hard-working non-achieving student A, the other of a non-working but achieving student B. *Four scales*: *four questions about their attitudes towards students, favouritism, praise, short-term expectation and long-term expectation * three modified items from the students' role-obligation scale (Chen & Wei, 2013)	Positive correlations between obligation-oriented and improvement-oriented beliefs about effort (r=0.49, p<0.001). Positive correlation between obligation-oriented belief about effort and entity theory of intelligence (r=0.36, p<.001). 1.Participants' obligation	H1 was supported, obligation-oriented beliefs are predictive of affective and behavioural attitudes towards struggling students who work hard, even if they do not achieve. H2 not supported: teachers' improvement-oriented beliefs did not	Obligation-oriented beliefs may be an important aspect of Confucian societies; in which they differ from Western societies. Improvement oriented beliefs do not inspire favouritism towards hard-working but mediocre students. Perhaps the fact that these students don't	This study takes a cultural view at a well-established field. It finds that perhaps the construct of effort needs to be divided into two parts. The first questionnaire only had four questions, one for each area of praise, favouritism, short-term and long-term expectation. This may not be adequate to capture views and there is not reliability check of these questions.

	long-term expectations of the smart student. 4.Teachers' entity theory of intelligence is positively correlated with their favouritism and praise of the smart student. 5.Teachers' entity theory of intelligence is negatively correlated with their short-term and long-term expectations of the struggling student. 6.Teachers' entity theory of intelligence is positively correlated with their short-		*five items developed to measure participants' improvement-oriented beliefs about effort (developed for this study) *three items scale for implicit theory of intelligence (Dweck, 1999) Two yes/no questions; have you ever taught a student like student A, student B?	oriented beliefs were positively correlated with favouritism (β=0.95, *p*<.001) and praise (β=0.73, p<.001) of student A. 2.participants' improvement oriented beliefs about effort were not significantly correlated with their short-term (β=0.07, ns.) and long-term (β=-0.13, ns.) of student A. 3.Participants improvement-oriented beliefs	predict their long and short term expectations for the struggling student. H3 is partially supported: improvement beliefs were predictive of their short-term expectations for the smart, not-working student, but not predictive of long-term expectations.	improve despite working hard, causes cognitive dissonance, which leads teachers to distance themselves from these students. Entity theory and improvement oriented beliefs are not negatively correlated in this data and they may therefore be separate constructs. This is different from how Dweck	22 participants did not pass the manipulation check for the vignettes and may have misunderstood the description of a smart student. This raises questions about the understanding of the participants who remained.

	term and long-term expectations of the smart student.			about effort were negatively related to their short-term expectation (β=-0.35, p<0.001) but not their long-term expectation (β=-0.10, *ns.*) for student B 4.Entity theory was positively correlated with favouritism (β=0.31, p<0.001) but not praise (β=0.15, *ns.*) of student B. 5.entity theory of intelligence was negatively correlated with	H4 is partially supported: entity beliefs were predictive of favouring the smart non-working student, but not predictive of the praise they would give this student. H5 was partially supported: entity beliefs were not correlated with teachers' short-term expectations, but were	conceptualises this. Although obligation-oriented beliefs and entity theory of intelligence are associated, the effects opposite; obligation orientation was positively correlated, but entity beliefs were negatively correlated with favouritism and praise of student A. Obligation orientation was negatively	

				teachers' long-term expectation of student A (β=-.23), but not their short-term expectation (β=-.11). 6. entity theory was not correlated with short-term or long-term expectations of student B (βs=-0.03, 0.03, *ns.*, respectively.	correlated with their long-term expectations of a struggling student. H6 was not supported: entity beliefs were not correlated with short-term or long-term expectations for the smart student.	associated, and entity theory was positively associated, with favouritism of student B. Also, obligation-oriented beliefs and improvement-oriented beliefs are associated, but their effect on favouritism of student A and praise of student B was opposite. This means according to Chen et al. that teachers may hold these three beliefs simultaneously and the effect	

						on their practice may be opposite. Of course, it is also possible that the scales don't measure what they set out to do? Although the CFA was acceptable	
Deemer (2004) *In Educational Research, 46:1*	1.There is a positive correlation between personal teaching efficacy, incremental theory of intelligence, perception of mastery-oriented school culture and mastery classroom goal orientation, mediated by mastery	99 high school science teachers (grades 9-12), female (*n*=50), male (*n*=49), 91% Caucasian, median teaching experience 11 years 1680 students, female (*n*=843)	Correlation study Scales: Teachers' report of mastery and performance instructional practice (*n*=4; α=0.79 and *n*=5; α=0.70) from Patterns of Adaptive Learning Survey (Midgley *et al.,* 1997).	Structural Equation Modelling Theory of intelligence did not account for either mastery (.10) or performance (-.04)	The 3-item measure for implicit theory of intelligence (Dweck & Henderson, 1989) may not be able to capture the complexity of teachers' theories of intelligence.	Although there was no significant association between theory of intelligence and mastery instructional practices, the associations between theory of intelligence and teacher	-Results may not be generalizable outside public high school setting -Small sample of teachers used in the path analyses, so the study was underpowered.

	instructional practices. 2.There is a negative correlation between personal teaching efficacy, incremental theory of intelligence, perception of mastery-oriented school culture and mastery classroom goal orientation, mediated by performance instructional practices. 3.There is a positive correlation between performance oriented school culture and performance instructional practices.	and male (*n*=837), 64% Caucasian and 19% African-American.	Teachers' perceptions of school culture (*n*=6; α = 0.71 and *n*=7; α =0.67) from Patterns of Adaptive Learning Survey (Midgley *et al.,* 1997). Teachers' theory of intelligence (*N*=3; α=0.94) (Dweck & Henderson, 1989). Personal teaching efficacy- adapted from Teacher Efficacy Scale (*N*=8; α= 0.79) (Gibson & Dembo, 1984). Students' perception of mastery classroom goal orientation (*N*=8; α=0.79) adapted from Ames & Archer (1988).	instructional practices. Incremental theory of intelligence was positively correlated to personal teacher efficacy (.21*). Theory of intelligence was not correlated to perceptions of either mastery school culture (.14) or performance school culture (.01).	Teachers self-report of mastery practises is higher than is perceived by students; perhaps due to social desirability of such practises. School culture may be more influential than teachers' goals because students typically interact with many teachers.	efficacy was significant, as well as the association between teacher efficacy and mastery instructional practices. The relationship between the three could be investigated further and see if teacher efficacy is the mediator between theory of intelligence and mastery instructional practices. There is no significant	-Forced choice surveys may not capture multi-faceted nature of teacher and student perceptions -No differentiation between approach and avoidance tendencies of performance goals -Measurement of school culture is complex; only teachers' perspectives were asked

				Both mastery instructional practices (.31*) and performance instructional practices (.41*) were associated with mastery school culture. Performance instructional practices were also significantly correlated with performance school culture.	Students' perception of goal orientation may be influenced by goals adopted by peers and promoted by parents.	association in the classroom practices as reported by teachers and the classroom goal orientation as reported by students, nor is there an association between theory of intelligence and classroom practices. Is it possible that students perceive the teachers' implicit goals, rather than the goals that they report to have?	
De Kraker-Pauw, Van Weel,	H1. Teachers with a more growth-oriented mindset	106 secondary school teachers in The Netherlands,	Correlation study.	Mindset (□=0.19, t=2.034, p=0.05) and gender	Growth-oriented teachers	It is important to make teachers	Small sample size in the second study, with mindset, gender and

Krabbendam & Van Atteveldt (2017) **Study 1:** *Full text in Frontiers in Psychology, vol 8*	are more positive in their appraisal of students' increasing achievements than those with a more fixed oriented mindset H2. The teachers' gender and teaching domain have an impact on their appraisal of achievement.	working with students aged 13–15. Female (*n*=43), male (*n*=63), STEM domain (*n*=27), non-STEM domain (*n*=79). Age range 22 to 61 (*M*=42.03, *SD*=11.76)	*Scales:* Theory of Intelligence (*N*=6; α=0.90) (Dweck, 2006) Reference Norm Orientation Test (*N*=12, α=0.81 for increasing marks, α=0.76 for non-increasing sufficient marks and α= 0.66 for non-increasing insufficient marks.	(□=032, *t*=3.396, *p*<0.001) were significant predictors of appraisal of achievement, with teachers with a growth mindset and female teachers giving higher appreciations of personal increasing improvements. There was no association between teaching domain and appraisal of achievement (□=0.10, *t*=1.033, *p*=0.30)	appreciate increasing marks more than fixed oriented teachers.	explicitly aware of their own mindsets, their feedback style and their students' mindsets, to optimise the effectiveness of the students' learning processes. Focusing on improvements has been shown to motivate students (Rheinberg & Engeser, 2010) and can help students to feel more	domain as variables, means that multiple regression analyses could not be conducted. Research was only within pre-vocational secondary education in the Netherlands, which is the lowest academic stream and may therefore have specific characteristics which is not generalizable to the entire population. Perhaps this stream of education attracts teachers who believe in growth.

De Kraker-Pauw, Van Weel, Krabbendam & Van Atteveldt (2017) **Study 2:**	H2a. Teachers with a growth mindset will provide more feedback than teachers with a fixed mindset. H2b. Teachers with a growth mindset will provide more growth-oriented feedback than fixed feedback	23 teachers, female (*n*=11) and male (*n*=12) from study 1, teaching either maths (*n*=11) or Dutch (*n*=12). No significant differences with regard to mindset scores or the appraisal of achievement with the original bigger sample of teachers.	Observational study, using video footage. Two researchers independently assessed comments expressing praise for 'doing' and 'being' (Krippendorff's α=0.92). Growth feedback was analysed using the process-oriented items from the Observation of Teacher Feedback Behaviour scoring form (Sol & Stokking, 2008). Fixed feedback was analysed using the result-oriented items from the same scoring form. Interrater reliability for 10 minutes of 4 videos was Krippendorff's α=0.88.	There was a significant negative correlation between mindset scores and total feedback interventions (*r*=-0.43, *p*=0.05) with teachers with a growth mindset giving less feedback than teachers with a fixed mindset. There was no correlation between mindset and either growth- oriented feedback (*r*=-0.37, *p*=0.09) or fixed oriented	Only 27.8% of all feedback was growth feedback, which is an important finding in the context of the rise of formative assessments within education. Teachers with a growth mindset provide less feedback. There is no support for Rattan et al (2012) notion that fixed mindset	competent. This is especially important for lower achieving students, who frequently find it difficult to manage their own learning processes (Hamstra & Van den Ende, 2006). Growth mindset does not necessarily translate to process-oriented or growth oriented feedback in the classroom. This is important in the context of	The theory of intelligence questionnaire is self-report and may be subject to social desirability effects; there may be a discrepancy with actual behaviours in the classroom.

			Fixed and growth feedback were calculated as percentage of total feedback for individual teachers, before calculating correlations with mindset.	feedback (r=0.24, p=0.28). No significant differences between total number of feedback between male and female teachers (t=0.168, df=20, p=0.87) or STEM and non-STEM teachers (t=-0.969, df=20, p=0.34). Male teachers provided more growth feedback than female teachers (t=2.129m df=20, p=0.05, d=0.90) and	teachers provide support in a comfort-oriented manner. It is possible that self-report of growth mindset could give a skewed picture, resulting in 'false growth mindset'. Mindset is measured as a general belief, but perhaps it is more context	formative assessments, which is focussed more on the process than the result. It is also important because of the impact that feedback has on motivation of students (Mueller & Dweck, 1998).	

				STEM teachers provided more growth feedback than non-STEM teachers (t=-2.304, df=20, p=0.03, d=1.05). Gender and domain were related in this sample; more male teachers in STEM and more female teachers in non-STEM.	specific and dependent on the characteristic of the individual student.		
Jones, Bryant, Snyder & Malone, (2012)	RQ1: how do preservice and in-service teachers define intelligence? RQ2:Do preservice and in-service teachers view intelligence	270 teachers, both preservice (n=237) and in-service teachers (n=33), female (n=216) and male (n=54). Age of in-service teachers (M=35.8,	Mixed-methods design. Scales: Definition of Intelligence (Jones et al., 2009), with an open ended question (N=1)	Group Comparison, correlation design Theory of intelligence (1=incremental-	77.9% of preservice and in-service teachers viewed intelligence as incremental. This is similar	Teacher educators need to examine how they convey beliefs about intelligence to preservice teachers; about	-There is not actual comparison between the % of incremental beliefs in this and other studies; the text says it is similar, but is 77.9% really statistically similar to

Full text in Teacher Education Quarterly	primarily as a malleable or fixed entity?	SD=9.5). Age of preservice teachers not reported. Teaching experience (*R*=1–31, *M*=9.0, *SD*=8.3)	Theory of Intelligence (*N*=3, α=0.92), (Dweck, 1999)	6=entity) for preservice teacher (*M*=2.54, *SD*=1.07) and in-service teachers (*M*=2.73, *SD*=1.30) did not significantly differ from each other *t*(265)=0.93, p-0.36. There was no significant correlation between intelligence beliefs and years of experience (*r*=0.15, *p*=0.42)	to other studies for students in different age groups. This sample of teachers reported more malleable views than high-school students, but less malleable views than elementary and middle school students. Perhaps people who choose a teaching	¼ held entity beliefs. This is important because they may underestimate the importance of effort, which is important to students' academic success.	90% or 97% reported in other studies? -most participants were female and white -in-service teachers were all enrolled on a course and perhaps not representative of in-service teachers in general

					career are more likely to believe that “anyone can learn” and therefore are more likely to have incremental views of intelligence. There was no difference between preservice and in-service teachers, but more than half of the in-service teachers had only 6 years or less experience. Perhaps there would be a		

					difference in a sample with more experienced teachers.		
Jonsson, Beach, Korp & Erlandson (2012)	H1. Maths teachers will have a higher preference for an entity theory of intelligence and a lower preference for an incremental theory, compared to teachers from other subjects. H4. Older teachers will have a lower preference for an entity theory of intelligence compared to younger and less experienced teachers.	226 teachers from Swedish high schools, female (*n*=110) and male (*n*=115). One participant did not disclose gender. Suburban, urban and rural schools were represented. Age range 21-65 (*M*=47), Experience range 0-40 (*M*=15). Subject teachers in group analysis: Maths and science (*n*=30)	Quasi-experiment. Deliberate sampling for heterogeneity, to make up for small sample size: Scales: Implicit theory of intelligence (Swedish translation of Dweck, 1999); Entity theory (*n*=4, α=.882) and Incremental theory (*n*=4, α=.874). Agreement with scientific theory of intelligence- rate agreement on a scale from 1-10 with CHC theory, Sternberg's triarcic theory of	H1 testing: 2x4 mixed ANOVA theory (entity vs incremental) and subject (maths/science, language, social sciences and practical) showed a main effect for implicit theory: entity theory *M*=3.61 and incremental theory *M*=6.26, $F(1,196)=73.55$, $p<0.001$. Interaction effect between implicit theory and discipline:	H1. Confirmed: Teachers in language, social science and practical disciplines showed higher preference for incremental theories and lower preference for entity theories. Math and science did not show this preference.	More consideration needs to be given to the education of maths teachers, as entity theories are d for student development. The current trend in teacher education for an increasing focus on subject content is too simplistic. Teacher education in mixed subject classes would	-Swedish sample may not generalise to teachers from other cultures in general. + an attempt was made to include teachers from schools in different types of area in Sweden, i.e. urban, suburban and rural. -the authors conclude that preference for an entity theory of intelligence is higher amongst maths

		Language (*n*=57) Social science/humanities (*n*=62) Practical (*n*=54) Left out of group analysis: PE (*n*=13) Special education (*n*=6) 4 teachers did not fill in their discipline and were left out of the analysis.	intelligence, Gardner's theory of multiple intelligences and the Soviet sociocultural theory.	*F*(1,196)=6.00, p<0.001. Maths and science teachers did not differ significantly between entity theory (*M*=4.69) and incremental theory (*M*=5.41), *t*(29)= −0.717, *p*<0.432. Language teachers did differ significantly between entity (*M*= 3.83) and incremental (*M*=5.64) theories, *t*(56)= −3.21, p<0.01. Social science teachers differed between entity (*M*= 3.29) and incremental	H4. Confirmed: Older teachers with experience and younger teachers without experience favour entity theories.	allow for an exchange of ideas between subjects through verbalisation and challenging of implicit beliefs. Future research needs to understand better what older teachers with experience and younger teachers without experience have in common and why they favour entity theories of intelligence.	teachers, compared to other subjects. However, there is no main effect of discipline on preference of intelligence theory.

				(*M*=6.53) theories, *t*(61)= -7.40, p<0.001 and teachers in practical disciplines differed between entity (*M*=3.12) and incremental (*M*= 7.14) theories, *t*(50)= -9.02, p<0.001. H4 testing: 2x4 ANOVA age (younger vs older) and experience (less vs more) showed no main effect of theory. However, there was an interaction effect involving age and experience F(3,212)=4.81, p<0.029. Older			

				teachers with more experience (*M*=4.47) preferred entity theory compared to older teachers with less experience (*M*=3.96). Younger teachers with less experience preferred entity theory (*M*=4.71) compared to younger teachers with more experience (*M*=4.23).			
Leroy, Bressoux, Sarrazin & Trouilloud (2007)	H1 The tendency to establish a given classroom climate depends on the teacher's self-efficacy, the implicit theories to which	336 fifth-grade teachers in France, female (*n*=211) and male (*n*=125) from 269 schools across France.	Correlation study/path analysis. Scales:	Incremental theory of intelligence predicts feelings of teacher self-efficacy (β=.22), which in turn	When teachers feel self-efficacy they reinforce students' needs for autonomy.	Teachers' beliefs about themselves and others play an important role in their	There seems to be a conflicting result: seniority is associated with entity theory (*r*=.11), and seniority is associated with self-efficacy (β=.13) and

	he/she subscribes, his/her seniority and the pressures he/she perceives coming from administration, colleagues and parents. H2 Adherence to an entity theory reduces autonomy support, whereas adherence to an incremental theory enhances this motivational climate H3 The relationship between incremental theory and the motivational climate in the classroom is a direct	Seniority (*M*=18,68, *SD*=11.88).	Teachers' self-efficacy scale (N=4, α=0.68) (Dussault, Villeneuve & Deaudelin, 2001) Implicit theory of intelligence, abridged version of Nature of Ability Beliefs Questionnaire (Sarrazin et al., 1996), investigating incremental beliefs (*n*=4, α=0.84) and entity beliefs (*n*=4, α=0.83). Constraints at work scale (*n*=15, α=0.71). Learning Climate Questionnaire (William & Deci, 1996, Black & Deci, 2000). (*N*=14, α=0.82).	predicted autonomy support in the classroom (β=.21). There was no direct effect of incremental theory on autonomy support. The mediating effect of incremental theory on autonomy support via teacher self-efficacy was not significant. The negative impact of entity theory on autonomy support was significant (β= -.18).	Incremental views of intelligence promote teachers' beliefs that they can help their students to make progress. Teachers with entity views of intelligence are more directive and support autonomy less. This may be because they try to establish at which level	motivational styles. It is important to promote teachers' self-efficacy, incremental views and reduce work pressures in order to promote an autonomy-supportive motivational climate. Making teachers aware of the processes involved in establishing this could help them	with autonomy (β=.21). But entity theory is negatively correlated with autonomy support (β= -.18). This does not seem to be explained.

	one, but is also mediated by the teacher's self-efficacy.			Seniority was associated with self-efficacy (β=.13) and with autonomy supportive climates (β=.21).	the students are able to succeed. Senior teachers feel more self-efficacious and support autonomy. Seniority in teaching is associated with entity views of intelligence.	to modify their classroom practices.	
Lynott & Woolfolk (1994) *Full text in Journal of Research*	RQ How do teachers' beliefs and implicit theories of intelligence relate to their ratings of the importance of three categories of educational goals?	319 elementary school teachers, female (n=293) and male (n=26). 181 invited teachers chose not to take part.	Correlation study/ factor analysis Three scales:	Nature of intelligence scores varied by years of experience: 1-5 years (*M*=7.6), 6-10 years (*M*=7.6), 16-20 years	Teachers have a tendency towards an incremental view of intelligence, but the range of beliefs is wide.	Because there is evidence that older teachers tend to hold entity beliefs, perhaps this is indicative of a developmental trajectory, in	Only 64% of invited teachers took part and this may have biased the results.

and Development in Educaton, 27:4			Dimensions of Intelligence–practical/academic (n=12, α=.93), conceptual thinking (n=12, α=.91) and social adaptiveness (n=12, α=.90) Nature of intelligence, either entity theory or incremental theory (*n*=11, α=.61) Educational Goals–practical/academic (n=4, α=.66), conceptual thinking (n=4, α=.73) and social adaptiveness (n=4, α=.75)	(*M*=6.4) and >20 years (*M*=5.6). No SD are reported. Significant correlation between teachers' years of experience and nature of intelligence (*r*=-.30, p<.01). There was a significant difference amongst groups F(4,219)=8.41, p<.001, with teachers over the age of 50 seeing intelligence as fixed (*r*=.27, p<.05).	Teachers who view intelligence as changeable tend to view practical and social behaviours as an indication of intelligence. More experienced teachers tend to see intelligence as fixed and stable. There is no association	which we all hold increasingly fixed beliefs as we age. However, a longitudinal design would need to investigate this hypothesis.	

				Significant but weak correlation between assumptions about nature of intelligence and practical knowledge dimension (*r*=.12, p<.05). No correlation between assumptions about nature of intelligence and thinking dimension (*r*=-.03).	between teachers' beliefs about intelligence as either fixed or malleable and their educational goals.		
Matteucci, Guglielmi & Lauermann (2017)	1a. Teacher responsibility is associated with teachers' self-efficacy beliefs	287 Italian public high-school teachers, female (*n*=181) and male (*n*=106). Age range 27-64 (*M*=49.95,	Correlation study/Path analysis. Scales:	H1a, 1b, 1c are supported: teacher responsibility is associated with teacher self-efficacy (β=.26),	Personal and contextual factors, such as self-efficacy, incremental beliefs and	Teacher responsibility has a mediating role between implicit beliefs and instructional	Only modest effect sizes, however, they are consistent with theoretical assumptions.

	1b. and with incremental beliefs of intelligence 1c. and with teachers' perceptions of a positive social climate in school, in terms of positive teacher-student relationships. 2a. Teacher responsibility is positively related to their career-choice satisfaction 2b. their endorsement of mastery practices 3. Teacher responsibility mediates between the predictor	*SD*=7.36). Teaching experience range 0-36 years (*M*=15.95, *SD*=10.49). Missing data ranged from 0-9%	Student relations subscale of the Revised School-Level Environment Questionnaire (Johnson et al., 2007) (N=4, α=.78) Implicit Theories of Intelligence (Dweck & Henderson, 1989) (N=3, α=.92) Teacher self-efficacy scale from the Patterns of Adaptive Learning Survey (PALS; Midgley et al., 1996) (N=6, α=.59) Teacher Responsibility Scale (Lauermann & Karabenick, 2013) (N=12, α=.94)	incremental theory of intelligence (β=.13) and school climate (β=.13). H2a, 2b, 2c are supported: teacher responsibility is associated with career-choice satisfaction, work engagement and mastery practices. H3. Partially supported: Apart from the indirect predictive effect of the predictors on the consequences via	school climate, have the potential to shape teachers' sense of responsibility for educational outcomes. Teachers who believe that they can influence student outcomes, who believe intelligence is malleable and who perceived relationships with students to be positive felt more responsible for work-	practices. Deemer (2004) found no relationships, but they did not take teacher responsibility into account.	Correlations do not evidence causal paths. All measures were based on self-report, so there may be influence of social desirability. Especially instructional practices and school climate would benefit from being assessed in other ways. Some of the scale had reliability below α=.70, which is typically used as a rule for internal consistency.

	variables self-efficacy, incremental beliefs of intelligence and perceived relational climate and consequences teachers' work engagement, career-choice satisfaction and mastery practices on the other hand.		Factors Influencing Teaching Choice Scale (Watt & Richardson, 2007) (N=2, α=.91) Utrecht Work Engagement Scale, short version (Schaufeli & Bakker, 2003) (N=9, α=.93) Mastery instructional practices from the Patterns of Adaptive Learning Survey (PALS; Midgley et al., 1996) (N=4, α=.62)	teacher responsibility, there were direct non-mediated effects. For example, Incremental theory is significantly correlated to teacher responsibility (β=.13) and work engagement (β-=.11) and marginally associated with mastery practices (β=.11).	related outcomes. This in turn made it more likely that they would be satisfied with their career, use mastery practices and be engaged in their work. Incremental beliefs indirectly predicted mastery practice, work engagement and career satisfaction, via teacher responsibility. This confirms		Self-selecting sample, because participation was voluntary.

					existing literature but also gives better understanding of the process of connecting implicit beliefs with behaviour.		
Patterson, Kravchenko, Chen-Bouck & Kelley (2016) *In Teaching and Teacher Education 59*	1a. Teachers will view teacher factors more important for students' academic performance than family or student factors. 1b. Self-perceived teaching efficacy is higher among preservice than practising teacher and will therefore emphasize teacher factors more	*Preservice teachers:* 73 (female *n*=65, male *n*=8). 89% no teaching experience, 14% had 1-2 years' experience. 86% were undergraduate, 14% were graduate students.	Correlation study. *Scales:* Perceptions of teacher, student, and family factors influencing student performance, *N*=14. Developed for this study; reliability is reported and combined reliability for preservice and practising teachers is α=0.88 for teacher factors, α=0.81 for	Repeated measures ANOVA: 1. Significant effect of factor, $F(1.80, 221.54)=41.40$, $p<0.001$, partial $\eta 2=0.43$. Bonferroni-corrected paired-samples t-tests showed that teacher factors	H1a was confirmed: teacher factors were considered more important than either student or family factors. There was no difference between student and family factors.	Teachers view their own role as most influential for student success. Whilst this can contribute to feelings of self-efficacy, it may also lead to disappointment or burnout if teachers set themselves unrealistic expectations	-This sample of teachers was in training and therefore this may have skewed their views of the importance of teacher factors. -The distinction between preservice and practising teachers does not seem to be entirely clear-cut, since preservice teachers

	strongly than practising teachers. 2a. Teachers use more ability-based attributions in STEM domain than in other domains. 2b. This is the same for both preservice and practising teachers. 3a. Stronger entity views of intelligence will be associated with higher scores on the measure of student factors influencing academic performance.	Age range: 18-35 (*M*=20.92, *SD*=2.96). An additional 18 respondents were not included in analyses because they had more than 2 years of prior teaching experience. *Practicing teachers*: 53 (female *n*=39, male *n*=14). Teaching experience 1-31 years (*M*=6.79, *SD*=7.03) All were enrolled in a graduate	student factors and α=0.87 for family factors. Implicit theory of intelligence (Dweck, 2000, *N*=8, α=0.95 for preservice and practising teachers combined). Domain-specific views of ability and effort, developed for this study, 7-point Likert scale. (*N*=22, α=0.77 for basic skills, α=0.86 for humanities, α=0.59 for STEM, α=0.70 for arts, α=0.50 for physical and α=0.89 for all items).	were more important than either student or family factors $t(124)=9.77$, $p<0.001$ and $t(124)=6.87$, $p<0.001$ respectively. Ratings for student and family factors did not differ from each other $t(124)= -0.53$, $p=0.60$. 1b. No significant factor by teacher status interaction. 2. Significant effect of domain,	H1b was not confirmed: preservice teachers did not emphasise teacher factors more strongly than practising teachers. H2a. was partially supported; teachers used more ability based attributions in STEM than in humanities, but not compared to basic and physical skills,	because they fail to take other contributing factors into account. The role of the teacher may be viewed differently in different cultures. More research is needed to find out what contributes to the ability vs effort attributions of teachers in different domains.	can have up to 2 years of teaching experience and practising teachers can have only 1 years' experience. This make the analysis of the difference less meaningful. -Practicing teachers may have worked in only one school and therefore not have been exposed to a range of student backgrounds. The student factors included components related to effort as well as intelligence and a mean score was calculated. This may have blurred the

	3b. and lower scores on teacher factors, 3c. as well as family factors. 3d. This pattern is the same for preservice and practising teachers. 3e. Stronger entity views of intelligence is associated with more ability-based views of performance in all academic domains; general beliefs are applied across specific domains. 3f. This will be the same for preservice and practising teachers.	programme in education. Age range 22-59 (*M*=30.98, *SD*=9.02) An additional 11 respondents were not included in the analysis because they had less than one year of teaching experience.		F(2.93, 363.82)=41.37, P<0.001, partial η 2=0.53. Bonferroni-corrected paired-samples t-tests showed more entity views in the arts domain; STEM views were the same as for basic and physical skills, which were lower than in arts but higher than in the humanities domain. There was no significant domain by status interaction; preservice teachers did not	and fewer than in the arts. H2b was supported H3a. was not supported: for practising teachers the endorsement of entity beliefs was related to lower endorsement of student factors, not higher, and for preservice teachers there was no significant difference.	Shifting general implicit theories of intelligence may not be sufficient to shift it in all domains, as the influence of intelligence beliefs varied across domains. Future research should investigate how intelligence beliefs interact with other teacher attitudes and classroom practices, such as helping students to	distinction with theories of intelligence. Effect sizes were not large, which means that caution needs to be taken when interpreting the results.

				differ from practising teachers. 3a. TOI in interaction with teacher status significantly predicted student factors for practicing teachers, β= –0.39, *t*= –3.02, *p*= 0.004, but not for preservice teachers β= 0.05, *t*=0.45, *p*= 0.65. 3b. First block of regression was significant, *F* (2,122) = 4.95, *p*=0.009. TOI beliefs were a	H3b. was supported: for both practising and preservice teachers, entity beliefs were related to the lower endorsement of teacher factors in promoting student performance. H3c. was not supported; higher entity beliefs did not relate to lower endorsement of family	overcome setbacks. Based on the study of Haimovitz & Dweck (2016) it may also be important to investigate teachers' implicit beliefs about failure. Teachers' ideas about what contributes to success may not be fully captured in their theory of intelligence; a more detailed	

				significant predictor on the teacher factor measure, β = –0.22, *t*= –2.56, *p*= 0.012. Teacher status was not a significant predictor and interaction between TOI and teacher status did not improve the fit, F(1,121)= 1.40, *p*= 0.24. 3c. TOI and teacher status did not predict endorsement of family factors *F*(2.122)= 1.81, *p*= 0.17. Interaction	factors for both practising and preservice teachers. H3d. was partially supported; patterns between practising and preservice teachers did not differ for teacher and family factors, but it did for student factors. H3e. was partially supported;	assessment may be required.	

				between TOI and teacher status did not improve model fit; $F(2.121) = 1.03$, $p = 0.31$. 3e. MANOVA examined the relations between theory of intelligence and ability beliefs. There was a significant effect of TOI, $F(5,119) = 3.48$, $p = 0.006$, partial $\eta 2 = 0.13$, but not of teacher status. TOI was significant predictor for basic skills $F(1,123) = 8.87$, $p = 0.003$;	stronger entity views of intelligence are associated with more ability-based beliefs in basic skills, humanities and STEM, but not in arts or physical skills. H3f. was supported; there was no difference in the relations between TOI and domain-specific ability/effort beliefs between preservice		

				humanities $F(1,123)=12.48$, $p=0.001$ and STEM $F(1,123)=14.46$, $p<0.001$. Stronger entity beliefs were associated with believing that ability is a determinant of performance in these areas. This was not true for arts or physical skills.	and practising teachers.		
Rattan, Good & Dweck (2012) **Study 1** *In Journal of Experimental*	Adults holding more of an entity (vs incremental theory are more likely to diagnose students' math ability from a single score on the first test of the year.	41 undergraduates, female ($n=27$) and male ($n=14$), imagining themselves in a teaching role. Age ($M=20.05$, $SD=1.64$)	Simulation experiment Implicit theory of maths intelligence ($N=4$, $\alpha=0.94$) (Good et al., in press)	Regression: Entity beliefs were associated with attributing poor performance to lack of maths intelligence ($B=0.40$,	Hypothesis was supported; entity theorists are more likely to diagnose students' maths ability	Entity theorists are more likely to diagnose students as having a low ability after a failed test. They might try to comfort the	+ the four studies give a complete picture of how implicit theories lead to judgement of others' abilities, giving of comfort and unhelpful pedagogical practices, but also how these practices lead to

Social Psychology 48			Sense of belonging to math (*N*=4, α=0.97) (Good et al., in press) Enjoyment of maths (*N*=4, α= 0.92) Belief in usefulness of maths (*N*=12, α=0.91; Fennema & Serman, 1976) Vignette: student scoring 65% on a test; 1. How much do you believe this is because she is not smart in math? 1 "do not believe at all-8 believe very much 2. Her grade on the test = % lack of hard work and %	*t*(39)=2.13, *p*<.05). Entity theorists attributed a greater percentage of a grade to lack of maths intelligence, as opposed to lack of hard work (*B*=6.74, *t*(39)=2.0, *p*=.05)	from a single score on the first test of the year.	student and use unproductive pedagogical practices. Even without spelling out their underlying beliefs of intelligence, they still communicate these through their practices. This leads to students feeling discouraged and unmotivated. Educational systems which focus on strengths and accepting weaknesses may therefore backfire and	implicit theories being perceived. -effect sizes not reported Over the four studies the measures change slightly, for example the beliefs about the failing students are assessed differently between study 2 and 3. Equally, the measure of unhelpful pedagogical practices changes between studies 2 and 3. As this is a replication of the study but with actual teachers, rather than undergraduates who imagine to be

			lack of maths intelligence.			this may lead to large amounts of students leaving STEM related fields.	teachers, it would have been helpful to keep the same measures in place. The group of teachers or teaching assistants is not very large (n=41) and it is debatable how much teaching TAs in a university course actually do.
Rattan, Good & Dweck (2012) **Study 2** *In Journal of Experimental Social Psychology 48*	Implicit entity theories of maths ability lead to potentially problematic pedagogical practices, such as comforting students for their presumed lack of aptitude in the subject.	95 undergraduates, female (n=87) and male (n=8), imagining themselves in a teaching role. Age unreported.	Experiment/correlation study. Participants read an article that manipulated implicit theories of maths intelligence. Manipulation check of implicit theory manipulation (α=0.92): Mindsets were successfully manipulated, with those in the entity condition (*M*=3.66, *SD*–.89) endorsing significant more fixed belief about maths than those in the incremental condition (*M*=2.46, *SD*=.81), t(93)=6.81, p<.01.	Entity theorist agreed significantly more that the student was not smart enough in maths, compared to incremental theorists (M_{ent}=4.07, *SD*=1.45, M_{incr}=2.67, *SD*=1.43, *t*(90)=4.01,*p*<.01) and attributed significantly more to a lack of intelligence as opposed to lack of hard work (M_{ent}=42.46, *SD* =19.48, M_{incr}=26.35, *SD*=17.55,	Implicit theories of maths intelligence plays a causal role in the early diagnosis of ability and pedagogical practices that follow.		

			1.Vignette from study 1: student scoring 65% on a test; 1. How much do you believe this is because she is not smart in math? 1 “do not believe at all–8 believe very much 2. Her grade on the test = % lack of hard work and % lack of maths intelligence. 2.Measure of pedagogical practices; comforting students (n=3, α=0.49) and enacting unhelpful pedagogical practices (n=4, α=0.46). Overall scale α=0.61.	t(90)=4.17, p<.01). Participants in entity condition endorsed comfort-oriented strategies and strategies that could reduce future achievement in maths overall (M_{ent}=3.18, SD =.89, M_{incr}=2.53, SD=.69, t(88,48)=4.03, p<.01). Entity theorist were more likely to console their students (M_{ent}=3.7, SD =1.37,			

				M_{-incr}=2.62, *SD*=.85, *t*(78.88)=4.62, *p*<.01) and use teaching strategies that could reduce engagement (M_{-ent}=2.79, *SD* =.94, M_{-incr}=2.45, *SD*=.74, *t*(93)=1.95, *p*=.05).			
Rattan, Good & Dweck (2012) **Study 3** *In Journal of Experimental Social Psychology 48*	Implicit entity theories of maths ability lead to potentially problematic pedagogical practices, such as comforting students for their presumed lack of aptitude in the subject.	41 graduate students who are instructors or teaching assistants at a undergraduate course, female (*n*=6) and male (*n*=35). Age (*M*=26.3, *SD*=2.91)	Implicit theory of maths intelligence (*N*=4, α=0.94) (Good et al., in press) Attitudes toward teaching (n=8, α=0.72). Vignette: undergraduate has received failing grade on a test.	Regression: Entity beliefs were associated with attributing poor performance to lack of maths intelligence (*B*=4.24, *t*(36)=2.25, *p*<.05).	Implicit theories of maths intelligence plays a causal role in the early diagnosis of ability and pedagogical practices that follow.		

			1. His grade on the test = % lack of hard work and % lack of maths intelligence 2. What is the likelihood that he will improve on the next test? (*N*=2, α=0.77) Measure of pedagogical practices; comforting students (*n*=4, α=0.75) and enacting unhelpful pedagogical practices (*n*=2, α=0.52). Overall scale *N*=6, α=0.77.	Entity theorists held lower expectations for future tests than incremental theorists (*B*=.45, *t*(36)=3.04, *p*<.01). Participants in entity condition endorsed comfort-oriented strategies and strategies that could reduce future achievement in maths overall, *B*=.36, *t*(36)=2.54, *p*<.05. Entity theorist were more likely			

				to console their students (*B*=.34, *t*(36)=2.15, *p*<.05) and use teaching strategies that could reduce engagement (*B*=.39, *t*(36)=2.26, *p*<.05).			
Shim, S.S., Cho, Y & Cassady, J. (2013)	H1. Teachers who are oriented to learning and extending their teaching competence are likely to create a mastery goal structure within their classrooms. Teachers who are oriented to demonstrate superior ability or mask inferior ability	209 in-service teachers, female (*n*=164) and male (*n*=45). Age range 22-65 (*M*=41.61, *SD*=11.73). Teaching experience range 1-41 years (*M*=14.09, *SD*=10.47). Teachers were from elementary schools (n=88), middle schools (n=	Correlation study. Scales: Patterns of Adaptive Learning Scales (Midgley et al., 2000). Mastery-oriented classroom instruction (n=4+additional n=3, α=.77) and performance-oriented classroom instruction (n=5, α=.76).	Multiple regression analysis *Mediation model:* Correlation Implicit theory and mastery classroom goal structure negative but not significant (*b*= -.13, *t*=-1.85, *p*<.07).	This study offers little evidence for the effect of teachers' implicit theories of students' intelligence on their goals for teaching or their goals in the classroom.	The widely held conceptual relationship between implicit theory of intelligence and achievement goals needs critical review. This widely held conceptual relationship needs critical review.	All measures were self-report, which may mean that the data is biased. Sample is subject to selection bias, which means that the results may not be generalizable to other settings.

	are likely to create a performance goal structure within their classroom. H2 Teachers' entity theory of intelligence will be linked to classroom performance goal structure. Q3 investigate the relationship between implicit theories of intelligence, achievement goals and classroom structures; is there mediation? Q4 Explore the interactions among achievement goals for teaching.	50) and high school (n=71). Schools were located in urban (47.3%) and rural areas (52.7%). 500 teachers had been sent an invite and had been asked to pass the invite on; return rate cannot be established.	Achievement Goal Orientations for Teaching (i.e. Butler, 2007) adapted for US. Mastery goal subscale (n=3, α=.82), performance-approach subscale (n=4, α=.81) and performance-avoidance approach (n=3, α=.70). Implicit theory of intelligence, modified to measure teachers' views of students' intelligence (Dweck, 1999; n=4, α=.71)	Correlation between mastery goal for teaching and mastery classroom goal structure positive but not significant (*b*=.39, *t*=6.03, *p*<.07). When mastery goal for teaching was entered as mediator, the correlation between implicit theory of intelligence and mastery classroom goal structure was smaller (*bs*: -.13 to -.03, *ps*:<.07	There was only evidence that teachers with an entity theory and a performance-avoidance goal for teaching pursue fewer performance goals in the classroom, thereby attempting to protect student self-esteem	It is not yet clear why teachers with an entity view of intelligence are less likely to promote a performance goal structure in the classroom. Mastery goals in the classroom may suffer from an environment in which performance goals are promoted, such as may be the case in the wider political climate.	Hypotheses are not described very clearly and the results are difficult to follow.

				to <.61) but most of observed patterns were not significant, so mediation not supported. Implicit theory of intelligence did not significantly correlate with classroom performance goal structure (*r*=05, *ns*), performance-approach goals for teaching (*r*=.13, ns) or performance-avoidance goals for teaching (*r*= -.01, ns). No mediation effect was further investigated.			

				Performance-avoidance goals for teaching interacted with implicit theory of students' intelligence; Performance-avoidance goals were negatively related to performance classroom structures in entity theory (*b*= -.28, *t*= -2.64, *p*<.01) but not related in incremental theory (*b*=.05, *t*=.49, *ns*)			
Stipek, D.J., Givven, K.B., Salmon, J.M. &	H1. Traditional beliefs about mathematics (transmitting rules	21 teachers, grade 4 to grade 6, female (*n*=20) and male (*n*=1).	Correlation study/principal component factor analysis.	Two factors, explaining 57% and 21% of the variance. First	Five dimensions of beliefs are strongly	Perhaps teachers who have entity beliefs feel the	The teacher questionnaire about evaluation and the student questionnaire

MacGyvers, V.L. (2001) *Full text in Teaching and Teacher Education 17.*	to students, as opposed to inquiry-based teaching) is associated with an entity theory of ability H2. And with the belief that the teacher needs to be in control of classroom instruction H3. And with the view that extrinsic, teacher-controlled rewards are an effective motivation tool for students H4. And with less self-confidence as a teacher H5. And with less enjoyment related	Experience range 1-20 years. 437 students, female (*n*=201), male (*n*=231) and non-disclosed gender (*n*=5).	Scales: Maths as a set of operations vs a tool for thought (*n*=5, α pre-and post-test=.75 and .73) Correct answers vs understanding as primary goal (n=7, α= .68 and.72) Teacher control vs child autonomy (n=6, α=.79 and .80) Entity vs incremental view of intellectual ability (n=11, α= .84 and .71)	factor comprised maths as operations, focus on correctness, teacher control, entity theory and extrinsic motivation (α=.90). The second factor comprised confidence and enjoyment (α=.84). Entity theorists place an emphasis on performance (*r*=.53, *p*<0.05) in their practice and on independence in their evaluations (r=.53, p<.0.05).	associated with each other: mathematics is a set of operations to be learned, students need to get correct solutions, the teacher needs to be in control, mathematical ability is stable and fixed, extrinsic rewards and grades are effective. Teachers who see ability as fixed place an	need to be in control because they assume students who struggle will not be able to use their mathematical ability productively. The result that entity theorists value independence seems counterintuitive. Perhaps the teachers conceptualised independence as 'not asking any questions', rather than being an	about competence and enjoyment of maths are not described well and no reliability statistics are reported. Inconsistent labelling of *p*-values makes it more difficult to interpret. They conclude that 'teachers who considered math ability to be a fixed trait perceived themselves to be less efficacious and had stronger needs to control student behaviour' (p.222) but they also show a correlation of *r*-.053, *p*<0.05 between entity

	to teaching mathematics. H6. Teachers with traditional beliefs about mathematics (as opposed to inquiry-oriented beliefs) will emphasize performance and efficiency H7. And will convey that mistakes need to be avoided, producing a high-risk environment H8. And will emphasize relative performance evaluations to parents.		Extrinsic vs intrinsic motivation (n=5, α= .67 and .63) Confidence in teaching maths (n=6, α= .81 and .79) Enjoyment of maths (n=3, α= .83 and .44). Video tapes of teacher practices, coded for: 1.Emphasis on performance 2.Emphasis on speed 3.High risk vs low risk environment 4. Opportunities for autonomy in students 5.Emphasis on effort 6.Focus on understanding		emphasis on performance in the classroom and value independence in their evaluation.	independent learner. Teacher beliefs and practices are linked and trying to change practices without trying to change beliefs is likely to fail.	theory and rating independence in grades or reports to parents. This seems inconsistent.

			7.Teachers' level of enthusiasm. Teacher questionnaire about evaluation, to what degree they used effort, relative scores, creativity and independence. Student questionnaire about their feelings of competence and enjoyment in maths.				
Tiekstra & Minnaert (2017)	RQ: what is the relationship between implicit theories of intelligence and actions of educational professionals regarding the care process of at-risk students?	36 school psychologists, 21 special service coordinators and 44 teachers, working in primary education. 14 school psychologists, 29 special service coordinators and 106 teachers were	Correlation study/ hierarchical regression/SEM. Scales Teachers' Implicit theory of intelligence (N=3, α=.77) (Dweck et al., 1995) Teacher behaviour questionnaire (N=9, α=73)	Significant association between implicit theory of intelligence and actions of the teacher (β=.58).	Implicit theories play a prominent role in teachers' actions in the classroom (34% of the variance of their actions was explained by this).	Implicit theories of teachers and support professionals are decisive for how students are supported. Entity theorist will consider problems to be within-child and will therefore make fewer adaptations in	No clear hypothetical relationships are stated. Participant details do not include information about gender, age or years of experience.

		invited but did not take part.	Support professionals' Implicit theory of intelligence (N=3, α=.75) (Dweck et al., 1995) Support professionals behaviour questionnaire (n=3, α=.58 and n=3, α=.55)		The prediction of teachers' actions by their implicit theories is stronger at Christian schools. Teachers with an entity view are more consistent in their actions towards students, however, as this is performance-oriented this could lead to stigmatization and self-fulfilling prophecies.	order to teach in the ZDP. Educational professionals should reflect on the influence of their implicit theories on all their actions. An incremental view on intelligence should be supported to create learning opportunities and exploration of students' ZDP, rather than focus on performance. Implicit theories play a role in interpretation of	Relatively low response rate (40.4%) may have biased results. Sample size was small. The teachers in this area of the Netherlands encounter many at-risk students and therefore may hold more flexible views than in the rest of the country; evidence for the role of implicit theories could have been stronger. Teacher and support professional's questionnaires are not validated; it may be

					Teachers with an incremental view on intelligence are less consistent; perhaps they do not know how to act according to their beliefs. In support professionals, implicit theories of intelligence predict the belief one has in IQ tests. Entity theories will attach more credibility to	test results and the consequent actions. This makes this an important issue for children who depend on the results of EP assessments.	subjected to demand characteristics

					IQ tests, which results in more static decision-making processes.		

Appendix E Reasons for exclusion

Reasons for exclusion

	Author and year	Title	Reason for exclusion
1.	-(2013)	Mindsets; how to motivate your students (and yourself)	Interview with Carol Dweck, not an empirical study involving teachers' mindsets
2.	Aljughaiman, A.M. & Ayoub, A.E. (2017)	Giftedness in Arabic environments; Concepts, implicit theories, and the contributed factors in the enrichment programs	Focus is on giftedness, not on either teacher mindsets or their impact on pedagogical practices
3.	Allen, K. (2016)	Developing mathematics identity.	Unable to obtain full text.
4.	Barnes, N. & Fives, H. (2016)	Creating a context for growth-focussed assessment.	No measure of teacher mindset was included.
5.	Daniels, D.H. & Shumow, L. (2003)	Child development and classroom teaching: a review of the literature and implications for educating teachers.	Not mindset related, not an empirical study.
6.	Dekker, S. & Jolles, J. (2015)	Teaching about "brain and learning" in high school biology classes: effects on teachers' knowledge and students' theory of intelligence.	Focused on students' mindset, but not on teachers' mindset.
7.	Fives, H. & Buehl, M. (2008)	What do teachers believe? Developing a framework for examining beliefs about teachers' knowledge and ability.	Focus is not on beliefs about intelligence, but beliefs about teaching knowledge and teaching ability.
8.	Harnett, J. (2012)	Reducing discrepancies between teachers' espoused theories and theories-in-use: an action research model of reflective professional development.	Study is not related to implicit theories of intelligence.
9.	Hu, X., Chen, Y. & Tian, B. (2016)	Feeling better about self after receiving negative feedback: when the sense that ability can be improved is activated.	Focused on students' mindset, not teachers' mindset.

10.	Kumar, R., Karabenick, S.A. & Burgoon, J.N. (2015)	Teachers' implicit attitudes, explicit beliefs, and the mediating role of respect and cultural responsibility on master and performance-focussed instructional practices.	Study investigates the impact of implicit beliefs of race, not implicit beliefs of intelligence.
11.	Lee, K. (1996)	A study of teacher responses based on their conceptualisations of intelligence	Unable to obtain full text.
12.	Lottero-Perdue, P.S. & Parry, E.A. (2017)	Perspectives on failure in the classroom by elementary teachers new to teaching engineering.	No measure of teacher mindset was included.
13.	Martín, E., Pozo, J.I., Mateo, Ml, Martín, A. & Del Puy Pérez Echeverría, M. (2014)	Infant, primary and secondary teachers' conceptions of learning and teaching and their relation to educational variables.	Study is not related to implicit theories of intelligence.
14.	Macret, N., Roussel, P. & Cury, F. (2015)	Using implicit measures to highlight science teachers' implicit theories of intelligence.	No measure of teacher mindset was included.
15.	Mascret, N., Elliot, A.J. & Cury, F. (2017)	The 3x2 achievement goal questionnaire for teachers.	Study is not related to implicit theories of intelligence.
16.	McWilliam E. (2014)	Accolades or achievement? Addressing the unforeseen consequences of therapeutic pedagogy.	Essay, not empirical study.
17.	Park, D., Gunderson, E.A., Tsukayama, E., Levine, S.C. & Beilock, S.L. (2016)	Young children's motivational frameworks and math achievement: relation to teacher-reported instructional practices, but not teacher theory of intelligence	Focused on students' mindset, not teachers' mindset.
18.	Salamon, A., Sumsion, J. Press, F. & Harrison, L. (2016)	Implicit theories and naïve beliefs: Using the theory of practice architectures to deconstruct the practices of early childhood educators.	This study uses a very different construct of implicit theories to the construct conceptualised by Dweck; the study is therefore not compatible with other studies included in the review.

19.	Schmidt, J.A. Shumow, L. and Kackar-Cam, H. (2015)	Exploring teacher effects for mindset intervention outcomes in seventh-grade science classes.	Focused on students' mindset, not teachers' mindset.
20.	Selleri, P., Carugati, F. & Scappini, E. (1995)	What marks should I give? A model of the organisation of teachers' judgements of their pupils	Not mindset related.
21.	Watanabe, M. (2010)	"Some people think this school is tracked and some people don't": using inquiry groups to unpack teachers' perspectives on detracking.	Not mindset related, not an empirical study.

Appendix F Ethics approval

Your Ethics Amendment (Ethics ID:27275) has been reviewed and approved

ERGO [ergo@soton.ac.uk]

To: Doedens-Plant A.C.R.

22 Ma

- Flag for follow up

Submission Number 27275:
This email is to confirm that the amendment request to your ethics form (An investigation into the contribution of their teachersÃ¯Â¿Â½?? implicit theories of failure to maths anxiety in secondary school pupils (Amendment 1)) has been approved by the Ethics Committee.

You can begin your research unless you are still awaiting specific Health and Safety approval (e.g. for a Genetic or Biological Materials Risk Assessment)

Comments
None
Click here to view your submission
Coordinator: Anna Doedens-Plant

ERGO : Ethics and Research Governance Online
http://www.ergo.soton.ac.uk

DO NOT REPLY TO THIS EMAIL

Appendix G Head teacher information letter

(Version Number 2, 19/05/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

Dear Mr or Mrs,

I would like to invite your school to take part in a study exploring anxiety and worry linked to maths in children and young people. Anxiety linked to maths is often associated with lower achievements in this subject in school and beyond. If we can understand better how maths anxiety develops, we can develop effective prevention and intervention methods for children and young people. The focus in this study is to understand how feelings and attitudes of teachers and parents are associated with young people's maths anxiety.

In this study, we will ask pupils, their parents and maths teachers to fill in a number of online questionnaires (see Appendix). We will ask parents and teachers to fill in three online questionnaires in the week beginning July 3. This should take around 10 minutes to complete. Pupils will be asked to fill in five questionnaires from the week starting July 3 during school, and at a time that is most convenient for them and the school. The five questionnaire should take no more than 20 minutes to complete.

I will inform all parents of students in years 7, 8 and 9 via parent mail about the study details and will make copies of all questionnaires available for them to see in school. Parents will be asked to inform the school if they are not happy for their child to take part. In addition, they will be sent a link for their own participation and consent to complete parent questionnaires. Participating children will be given the opportunity at the start of their participation to opt out, if they do not wish to take part. If they decide to fill in the questionnaires, then their assent to participate is recorded. We would like all the maths teachers in your school to take part, but they will be given the opportunity to opt out if they do not wish to do so.

Appendix G

All data will be collected anonymously; all participants will receive a unique number, but I will not record any names and participants will not be identifiable. All participants in the study will have the opportunity to change their mind and withdraw their data from the study, up until August 1. If they do so, their data will be discarded.

As a thank you for taking part, every participant gets the chance to win a cash prize: there are two £100 prizes to be won, as well as four £50 prizes, ten £20 and twenty £10 prizes.

I have attached a form requesting your formal consent for the study to take place in your school, as well as all relevant information letters and consent forms for students, parents and teachers. I do hope that you will take this exciting opportunity for your school to take part in this research, which could help to shape the way we support children and young people in their maths education. If you have any further questions, please contact me via email: acdp1g15@soton.ac.uk.

Thank you in advance for taking part.

Anna Doedens-Plant

Trainee Educational Psychologist.

Assessment of implicit theory of mathematical intelligence for children, parents and teachers (Dweck et al., 1995)

1. You have a certain amount of mathematical intelligence and you really can't do much to change it.
2. Your mathematical intelligence is something about you that you cannot change very much.
3. You can learn new things but you can't really change your basic mathematical intelligence.

Children, teachers and parents state their agreement with these statements on a 6-point scale, ranging from 1 (strongly agree) to 6 (strongly disagree). Scores are averaged over the three items. Scores below 3.0 indicate an entity theory of intelligence, or fixed mindset, whereas scores above 4.0 indicate an incremental theory of intelligence, or growth mindset.

Assessment of implicit theory of failure in maths for children, parents and teachers (Haimovitz & Dweck, 2016)

1. The effects of failure in maths are positive and should be utilised.
2. Experiencing failure in maths facilitates learning and growth.
3. Experiencing failure in maths enhances performance and productivity.
4. Experiencing failure in maths inhibits learning and growth.
5. Experiencing failure in maths debilitates performance and productivity.
6. The effects of failure in maths are negative and should be avoided.

Children, teachers and parents state their agreement with these statements on a 6-point scale, ranging from 1 (strongly agree) to 6 (strongly disagree). A composite variable will be created by reverse scoring the items that represent that failure is positive; lower scores will therefore represent a more debilitating view of failure.

Assessment of children's perception of parents' goal orientation (Friedel et al., 2007)

1. My parents want me to understand maths concepts, not just do the work.

2. My parents want me to understand maths problems, not just memorize how to do them.
3. My parents would like me to do challenging maths problems, even if I make mistakes.
4. My parents think that how hard I work in maths is more important than the marks that I get.
5. My parents think that mistakes in maths are okay as long as I learn from them.
6. My parents want me to spend time thinking about maths concepts.
7. My parents don't like it when I make mistakes in maths.
8. My parents would like it if I could show that I'm better at maths than other people in my class.
9. My parents ask me how my work in maths compares with the work of other people in my class
10. My parents would like me to show others that I'm good at maths.
11. My parents would be pleased if I could show that maths is easy for me.

Children state their agreement with these statements on a 6-point scale, ranging from 1 (strongly agree) to 6 (strongly disagree). Items 1-6 will be reverse scored, so that a lower total score will reflect that they perceive their parents to have a tendency towards performance goals, whereas a higher score will reflect that they perceive their parents to tend towards learning goals.

Children's perception of teacher's goal orientation (Friedel et al., 2007)

1. My teacher really wants us to enjoy learning new things in maths.
2. My teacher gives us time to really explore and understand new ideas in maths.
3. My teacher recognises us for trying hard in maths.
4. My teacher thinks mistakes in maths are okay as long as we are learning.
5. My teacher wants us to understand our maths work, not just memorise it.

6. My teacher lets us know which people get the highest scores in a maths test.
7. My teacher points out those people who get good marks in maths as an example to all of us.
8. My teacher tells us how we compare in maths to other people.
9. My teacher lets us know if we do worse in maths than most of the other people in the class.
10. My teacher makes it obvious when certain people are not doing well in their maths work.

Children state their agreement with these statements on a 6-point scale, ranging from 1 (strongly agree) to 6 (strongly disagree). Items 1-6 will be reverse scored, so that a lower total score will reflect that they perceive their teacher to have a tendency towards performance goals, whereas a higher score will reflect that they perceive their teacher to tend towards learning goals.

Shorter Maths Anxiety Rating Scale for children, parents and teachers (Alexander & Martray, 1989)

Rate on a scale from 1 -5 how anxious you would feel in each of these situations, where: 1 is 'not at all anxious', 2 is 'a little anxious', 3 is 'fairly anxious', 4 is 'quite anxious' 5 is 'very anxious'

1. Studying for a maths test	1 2 3 4 5
2. Taking maths section of a college entrance exam	1 2 3 4 5
3. Taking an exam (quiz) in a maths course	1 2 3 4 5
4. Taking an exam (final) in a maths course	1 2 3 4 5
5. Picking up a maths textbook to begin working on a homework assignment	1 2 3 4 5
6. Being given homework assignments of many difficult problems that are due the next class meeting	1 2 3 4 5
7. Thinking about an upcoming maths test 1 week before	1 2 3 4 5

8. Thinking about an upcoming maths test 1 day before 1 2 3 4 5

9. Thinking about an upcoming maths test 1 hour before 1 2 3 4 5

10. Realising that you have to take a certain number of maths classes to fulfil requirements 1 2 3 4 5

11. Picking up a maths textbook to begin a difficult reading assignment 1 2 3 4 5

12. Receiving your final maths mark in the post 1 2 3 4 5

13. Opening a maths or statistics book and seeing a page full of problems 1 2 3 4 5

14. Getting ready to study for a maths test 1 2 3 4 5

15. Being given a 'fun' quiz in a maths class 1 2 3 4 5

16. Reading a till receipt after your purchase 1 2 3 4 5

17. Being given a set of numerical problems involving addition to solve on paper 1 2 3 4 5

18. Being given a set of subtraction problems to solve 1 2 3 4 5

19. Being given a set of multiplication problems to solve 1 2 3 4 5

20. Being given a set of division problems to solve 1 2 3 4 5

21. Buying a maths textbook 1 2 3 4 5

22. Watching a teacher work on an algebra equation on the blackboard 1 2 3 4 5

23. Signing up a for a maths course 1 2 3 4 5

24. Listening to another student explain a maths formula 1 2 3 4 5

25. Walking into a maths class 1 2 3 4 5

Appendix H Head teacher consent form

(Version Number 1, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

Please initial the boxes below if you agree with the statement(s):

I understand that my school's participation in this study will involve assisting

Anna Doedens-Plant with the following:

- Selection of students.
- Obtaining consent from parents via parent email
- Identification of a named staff member in school whom students could approach for support if required.
- Group session in school to complete standardised questionnaires.
- Data collection in school during academic year 2016/2017 or 2017/2018
- Providing staff members to monitor data collection.
- Provide a separate task/activity for any students who do not wish to participate in the survey. ☐

I have read and understood the following documents in connection with the

the study:

Document	***Version***	***Please initial***
		☐

Appendix H

Information letter to parents requesting their own and their children's full participation	Version 1	☐
'Opt-out' consent email/letter to parents	Version 1	
Parental participation consent form	Version 1	☐
Student information letter	Version1	☐
Student consent form	Version 1	☐
Student opt-out form	Version 1	☐
Information letter to teachers, requesting full participation	Version 1	☐
Teacher participation consent form	Version 1	☐
Teacher opt-out form	Version 1	☐
Questionnaires for students, parents and teachers	Version 1	☐

Further to reading the above documents, I have had the opportunity to ask questions about the study.	☐
I understand that I remain free to direct any future questions, comments or concerns about the study as they arise, to Anna Doedens-Plant.	☐
I understand that I am at liberty to contact the Southampton University Ethics Committee to discuss any complaints I may have pertaining to this research.	☐
I understand that the data collected by the University of Southampton will remain anonymous and will only be accessible by the University.	☐

I have seen and approved all of the questionnaires used in the study.

I consent to Anna Doedens-Plant conducting this study in my school. ☐

I am available to speak to any parents who are unhappy with the opt-out consent. ☐

Name of School.....

Name of Headteacher.....

Signature of Head Teacher.....

Date.....
....

Appendix I Parent/guardian information sheet and opt-out form

(Version 1, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

Dear Parent/ Guardian,

I would like to invite you and your daughter or son to take part in a study looking at their worries and anxiety around maths. The aim of this letter is to explain what the study involves and to give you the opportunity to tell the school if you do not want your child to be part of it.

Please read this information carefully before deciding whether or not you, or your child, want to take part in this research project.

If you would like your child to be withdrawn from data collection please return the opt-out form (below) to your child's tutor by June 1, 2017.

What is the study about?

With this study we aim to look at how feelings about maths in teachers and parents is linked to worry that young people might have about learning maths.

Why is the study important?

We know that young people who worry about maths tend to show lower achievement in this subject in school and beyond. If we can understand why some young people develop worries about this subject, then we are in a better position to help them to achieve.

Why have you and your child been chosen?

You have been chosen because your son or daughter is in year 7, 8 or 9.

What will it involve?

You will be asked to fill in three online questionnaires, **which should take no longer than 10 minutes to complete.** Your son or daughter will be asked to fill in five online questionnaires in school, which should take around 15-20 minutes to complete. Their maths' teacher will also be asked to fill in three online questionnaires.

How, when and where will the study take place?

The study will only entail online surveys and will take place towards the end of the summer term. At this time, you and your child's maths' teacher will be sent an email, which contains the links to the online survey which they will be asked to complete during that week. One week later children whose parents have not withdrawn them from the study will be asked to fill in the surveys at school. Your child is asked if they want to take part and they are given an opportunity to not complete the questionnaires if that is what they decide.

Will our information be anonymous and confidential?

Yes. Every participant will be given a unique participation number and no names are recorded, all data is entirely anonymous. All data will be stored within electronic data files on a secure server at the University of Southampton or on an encrypted memory device.

Are there any benefits in taking part?

As a thank you for taking part every parent and child gets the chance to win: there are two £100 prizes to be won, as well as four £50 prizes, ten £20 and twenty £10 prizes and participation numbers are also used to randomly select the winners.

Are there any risks involved?

Our priority is to ensure the wellbeing of your child as a participant. Every effort will be made to ensure that their participation in the study is a positive experience, and that your child remains happy to complete the survey. Although we have deemed the survey to be low risk, there is always the possibility that some young people might experience increased worry whilst taking part in the survey. If your child experiences any discomfort, they will be free to stop the survey. In addition, we would encourage them to discuss any negative feelings with you or another supportive adult (e.g., a member of staff in school).

What happens if you change your mind?

If you or your son/daughter decide that you no longer wish to take part in the study, you can withdraw your own and your son's/daughter's data from the study. This means that your data will not be used to inform the results of the study. If you wish to do so, please send an email expressing the wish to withdraw your consent, together with your participant number, to acdp1g15@soton.ac.uk.

What happens if something goes wrong?

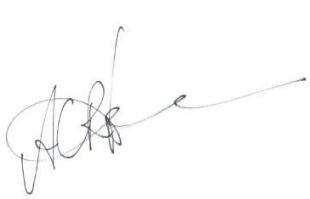
Appendix I

In the unlikely event that you feel that you have been placed at risk, you can contact the Chair of the Ethics Committee at the University of Southampton: Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk.

Where can I get more information?

If you would like more information with regards to this research, please email me at acdp1g15@soton.ac.uk.

Thank you in advance for taking part.



Anna Doedens-Plant

Trainee Educational Psychologist

OPT-OUT CONSENT FORM

(Version 1, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number:

If you would like your child to be withdrawn from data collection please return the opt-out form (below) to your child's tutor by June 1, 2017

Please initial the boxes to indicate that you agree with the statements

I do not wish for my child to take part in the online surveys ☐

I understand that the school will arrange an alternative task whilst the surveys take place ☐

I have read and understood the Participant Information Sheet (Version Number 1, 28/02/17) and I have had the opportunity to ask questions about the study ☐

If you would like to give reason why your child should not take part please use the space provided below:

We would like to thank you again for your time and consideration of the study

Name (print name)…….....

Childs Name (print name) ……...

Child's tutor group……..

Contact Phone Number.....

Appendix I

Contact Email Address (optional).....

Signature…….....

Date……

Appendix J Teacher participant information sheet and opt-out form

(Version 1, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

Dear teacher,

I would like to invite you to take part in a study around maths anxiety in children and young people. The aim of this letter is to explain what the evaluation involves and to give you the opportunity to opt out of the study.

Please read this information carefully before deciding whether or not you want to take part in this research project. If you would like to be withdrawn from data collection please return the opt-out form (below) me by June 1, 2017.

What is the study about?

With this study we aim to look at how feelings and attitudes of teachers and parents may or may not contribute to young people's worries and anxiety about learning maths.

Why is the study important?

The study of maths anxiety is important, because it is associated with lower achievements in maths. If we can understand better how maths anxiety develops, we are in a better position to help children and young people achieve in this subject at school.

Why have you been chosen?

You have been chosen because you teach maths to students in year 7, 8 or 9.

What will it involve?

You will be asked to fill in three online questionnaires, **which should take no longer than 10 minutes to complete.** Your students will also be asked to fill in five online questionnaires, which should take around 15-20 minutes to complete. Their parents will also be asked to fill in three online questionnaires.

How, when and where will the study take place?

The study will only entail online surveys and will take place towards the end of the summer term. Parents and teachers will be sent an email, which contains the links to the online survey which they will be asked to complete during that week. Children of parents who have not opted their child out of the study will be asked to fill in the surveys at school, at a moment which is convenient for the school to arrange. All children will be given the opportunity to opt out of the study before taking part.

Appendix J

Will my information be anonymous and confidential?

Yes. Every participant will be given a unique participation number, to allow for matching between children and their teachers, but as no names are recorded, all data is entirely anonymous. All data will be stored within electronic data files on a secure server at the University of Southampton or on an encrypted memory device.

Are there any benefits in taking part?

As a thank you for taking part every participant gets the chance to win a cash prize: there are two £100 prizes to be won, as well as four £50 prizes, ten £20 and twenty £10 prizes and these participation numbers are also used to randomly select the winners.

Are there any risks involved?

Our priority is to ensure the wellbeing of all our participants. Every effort will be made to ensure that your participation in the study is a positive experience. Although we have deemed the survey to be low risk, there is always the possibility that some people might experience increased worry whilst taking part in the survey. If you experience any discomfort, you will be free to stop the survey. In addition, we would encourage you to discuss any negative feelings with you or another supportive adult (e.g., a member of staff in school).

What happens if you change your mind?

If you decide that you no longer wish to take part in the study, you can withdraw your data from the study. This means that your data will not be used for the statistical analysis and will not inform the results of the study. If you wish to do so, please send an email before August 1 expressing the wish to withdraw your consent, together with your participant number, to acdp1g15@soton.ac.uk.

What happens if something goes wrong?

In the unlikely event that you feel that you have been placed at risk, you can contact the Chair of the Ethics Committee at the University of Southampton: Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk.

Where can I get more information?

If you would like more information with regards to this research, please email me at acdp1g15@soton.ac.uk.

Thank you in advance for taking part.

Anna Doedens-Plant

Trainee Educational Psychologist

OPT-OUT CONSENT FORM

(Version 1, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number:

If you would like to be withdrawn from data collection please return the opt-out form (below) to your child's tutor by June 1, 2017

Please initial the boxes to indicate that you agree with the statements

I do not wish to take part in the online surveys ☐

I have read and understood the Teacher participant Information Sheet ☐
(Version Number 1, 28/02/17) and I have had the opportunity
to ask questions about the study

If you would like to give reason why you do not want to take part please use the space provided below:

We would like to thank you for considering to take part in the study

Name (print name)…….....

Contact Email Address (optional).....

Signature…….....

Date……

Appendix K Student information sheet and participant consent form for students, parents and teachers

STUDENT PARTICIPANT INFORMATION SHEET

(Version 1, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

Hello!

I would like to invite you take part in a study around maths anxiety in children and young people. Your parents have given permission for you to take part, but you can decide whether you would like to or not. If you decide not to take part, you will be given a different activity to do in this lesson. **If you would like to be withdrawn from data collection please fill in the opt-out form (below).**

It is important to study maths anxiety, because children who feel anxious about maths tend to do less well in it. If we can understand better how maths anxiety develops, we will be better able to help children with this or even prevent maths anxiety from happening in the first place. With this study I want to look at how the feelings and attitudes of your parents and teachers makes a difference to how you feel about maths.

By taking part you get the chance to make a difference by contributing to research in education! And you get the chance to win a prize. There are two £100 prizes to be won, as well as four £50, ten £20 and twenty £10; this means there are 36 chances to win a prize!

Thank you for helping me with this research.

Anna Doedens-Plant

Trainee Educational Psychologist

You will shortly be asked to fill out 5 questionnaires. This should take about 15-20 minutes to complete, even when you think about the answers carefully. All answers are anonymous: we don't record your name, your parent's name or your teacher's name. Nobody will be told what you filled in on your survey; please be completely honest in your answers. Once you have answered the questions, you can change your mind and ask me to not use your answers by emailing me your participant number, and telling me you would like to withdraw from the study, before August 1, on acdp1g15@soton.ac.uk.

Click here to say that you would like to take part and start on the first survey:

Link to consent form and surveys

OPT-OUT CONSENT FORM

(Version 2/ 07/09/2015)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

If you would like to be withdrawn from data collection please fill in the opt-out form (below)

Please initial the boxes to indicate that you agree with the statements

I do not wish to take part in the online surveys ☐

I understand that the school will arrange an alternative task whilst the surveys take place ☐

I have read and understood the Student Participant Information Sheet (Version Number 1, 28/02/17) and I have had the opportunity to ask questions about the study ☐

If you would like to give reason why you do not want to take part please use the space provided below:

Appendix K

We would like to thank you for considering to take part in the study

Name (print name)…….....

Tutor group……..

Contact Email Address (optional).....

Signature…….....

Date……

STUDENT CONSENT FORM

(Version Number 01, 28/02/2017)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant
Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke
Ethics number: 25773

Please tick the box(es) if you agree with the sentences below:

I understand that my parent has given permission for me to take part in this study	☐
I understand that I can agree or disagree to take part in the study and that nobody will be upset or disappointed if I decide that I don't want to take part	☐
I understand that I can decide not to take part even if my parent or carer has given their permission for me to take part	☐
My parent or carer has talked with me about the study and whether or not I would like to take part	☐
I have had the chance to ask questions about the study and talk about anything that is worrying me about taking part	☐
I understand that my data will be stored safely to keep it private	☐
I understand that it will not be possible for anybody reading the research report to be able to tell that I took part in this study	☐
I understand that I can change my mind or decide to stop taking part in the study at any time, or withdraw my information before 01.08.17 without needing to give a reason	☐
I agree to take part in this study	☐

Name of participant (print name)……...

Signature of participant……...

Date……

PARENT CONSENT FORM

(Version Number 01, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant
Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke
Ethics number: 25773

Please tick the box(es) if you agree with the sentences below:

I have been given information about the study, explaining its aims and who has been asked to take part	☐
I have had the chance to ask questions about the study and talk about anything that is worrying me about taking part	☐
I understand that my data will be collected anonymously and stored safely to keep it private	☐
I understand that it will not be possible for anybody reading the research report to be able to tell that I took part in this study	☐
I understand that I can change my mind or decide to stop taking part in the study at any time, without needing to give a reason and can withdraw my data up until August 1, 2017	☐
I agree to take part in this study	☐

Name of participant (print name)……...

Signature of participant……...

Date……

TEACHER CONSENT FORM

(Version Number 01, 28/02/17)

Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant
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Ethics number: 25773

Please tick the box(es) if you agree with the sentences below:

I have been given information about the study, explaining its aims and who has been asked to take part	☐
I have had the chance to ask questions about the study and talk about anything that is worrying me about taking part	☐
I understand that my data will be collected anonymously and stored safely to keep it private	☐
I understand that it will not be possible for anybody reading the research report to be able to tell that I took part in this study	☐
I understand that I can change my mind or decide to stop taking part in the study at any time, without needing to give a reason and can withdraw my data up until August 1, 2017	☐
I agree to take part in this study	☐

Name of participant (print name)……...

Signature of participant……...

Date……

Appendix L Participant debrief sheets

PARENT/GUARDIAN DEBRIEF SHEET

(Version 1, 28/02/17)
Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant

Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke

Ethics number: 25773

Dear Parent/Guardian

Thank you very much for participating in this research; I very much hope that you enjoyed the opportunity to take part. Your participation in our research will help us to better understand how parents' and teachers' thoughts and feelings about maths may contribute to children's potential concerns and worries about learning maths in school. Understanding this is important, because this may put us in a better position to help children and young people achieve in this subject.

I would like to remind you that you have the right to withdraw your data, by emailing me up until August 1. If you do so, this means that the information you have provided will not be used in my report. If you do not contact me, then your data will be used anonymously, which means that no names will be recorded and all care will be taken to make sure that it is not possible to identify you through the write-up of my research.

If you do decide to withdraw your data, or if there is anything that you would like to discuss further, please feel free to contact me on the following email address: acdp1g15@soton.ac.uk

I would like to thank you again for taking part; I appreciate it.

Yours sincerely,

Anna Doedens-Plant

Date:

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

STUDENT DEBRIEF SHEET
(Version 1, 28/02/17)
Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant
Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke
Ethics number: 25773

Dear Student,

Thank you very much for taking part in this research; I very much hope that you enjoyed it. Your participation in my research will help us to better understand why some children and young people feel anxious about maths. Understanding this is important, because it will help us to support those who do struggle with maths anxiety and perhaps it will even help us to make sure it doesn't happen in the first place! It will also help us to understand if your worries and concerns are linked to those of your parent or teacher. If there is anything that you are worried about after taking part in this research, please discuss this with an adult, at school or at home, that you feel comfortable with. You can also contact me on my email, acdp1g15@soton.ac.uk, and we can arrange to talk about it over the phone or in person.

I would like to remind you that you have the right to withdraw your data, by emailing me up until August 1. If you do so, this means that the information you have provided will not be used in my report. If you do not contact me, then your data will be used anonymously, which means that no names will be recorded and all care will be taken to make sure that it is not possible to identify you through the write-up of my research.

If you do decide to withdraw your data, or if there is anything that you would like to discuss further, please feel free to contact me on the following email address: acdp1g15@soton.ac.uk.

I would like to thank you again for taking part; I appreciate it.
Best wishes,

Anna Doedens-Plant

Date:

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Appendix L

TEACHER DEBRIEF SHEET

(Version 1, 28/02/17)
Study Title: *An investigation into the contribution of their teachers' implicit theories of failure to maths anxiety in secondary school pupils*
Researcher: Anna Doedens-Plant
Supervisors: Dr Julie Hadwin, Dr Sarah Wright, Mr Tim Cooke
Ethics number: 25773

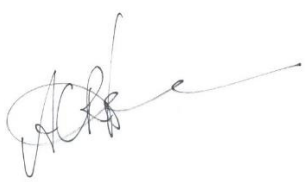
Dear teacher,

Thank you very much for participating in this research; I very much hope that you enjoyed the opportunity to take part. I feel that your participation in our research will help us to better understand which factors may contribute to children's maths anxiety. Understanding this is important, because this may put us in a better position to develop effective prevention and intervention methods for children and young people.

I would like to remind you that you have the right to withdraw your data, by emailing me up until August 1. If you do so, this means that the information you have provided will not be used in my report. If you do not contact me, then your data will be used anonymously, which means that no names will be recorded and all care will be taken to make sure that it is not possible to identify you through the write-up of my research.

If you do decide to withdraw your data, or if there is anything that you would like to discuss further, please feel free to contact me on the following email address: acdp1g15@soton.ac.uk

I would like to thank you again for taking part; I appreciate it.
Yours sincerely,



Anna Doedens-Plant

Date:

If you have questions about your rights as a participant in this research, or if you feel that you have been placed at risk, you may contact the Chair of the Ethics Committee, Psychology, University of Southampton, Southampton, SO17 1BJ. Phone: +44 (0)23 8059 3856, email fshs-rso@soton.ac.uk

Appendix M Spearman's Rho correlation table

	1	2	3	4	5	6	7	8	9	10	11	12
Parent reports												
1.Theory of intelligence	-											
2.Theory of failure	.11	-										
3.Maths Anxiety	-.30**	-.18	-									
Teacher reports												
4.Theory of intelligence (high or low)	.12	.18	-.14									
5.Theory of failure (high or low)	.01	.06	-.00	.49**								
Pupil reports												
6.Theory of intelligence	.06	.02	-.03	-.04	.02	-						
7.Theory of failure	-.19	-.02	-.20	-.06	.08	.25**	-					
8.Perception of parents' goals	.16	.07	.01	-.02	.02	.22**	.33**	-				
9.Perception of maths teacher's goals	.04	.04	.06	.08	.12**	.21**	.29**	.36**	-			
Other factors												
10. Maths Anxiety	.14	-.13	.12	.00	.05	-.06	-.13**	-.08*	-.09**	-		
11. Maths set	.08	-.07	.27*	.13**	-.07	-.18**	-.18**	-.04	-.12**	.19**		
12. Gender	-.14	.05	-.03	.04	.03	-.07*	-.04	-.22**	-.13**	-.14**	.06	-

Note: *p<.05, **p<.001. Teachers N=9, Parents N=84, Pupils N=859

Appendix N Demographic questions for young people

Please tell us a bit about yourself:

I am female	I am male	I would rather not disclose my gender
○	○	○

Which group are you in for maths (for example: 7Y3, 8X6)?

What is the survey code name for your teacher? (for example, Madrid, London)

What is your participant number? (for example: 7038, 9120)

Please tell us a little bit about your background

a) Black or Black British

- ○ Caribbean
- ○ African
- ○ Any other Black background within (a)

b) White

- ○ British
- ○ Irish
- ○ American
- ○ Any other White background

c) Asian or Asian British

- ○ Indian
- ○ Pakistani
- ○ Bangladeshi
- ○ Any other Asian background within (c)

d) Mixed

- ○ White & Black Caribbean
- ○ White & Black African
- ○ White & Asian
- ○ White & Hispanic
- ○ Any other mixed background

e) Other ethnic groups

- ○ Chinese
- ○ Japanese
- ○ Hispanic
- ○ Any other ethnic group
- ○ Do not state

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