

*Are interventions promoting a growth mindset effective in raising
academic achievement in school-aged pupils?*

Section 1: Summary

This systematic literature review aims to assess how effective a growth mindset intervention is at raising the academic attainment of school-aged pupils. Research suggests that interventions aimed at promoting a growth mindset can lead to improved academic outcomes, including academic attainment. Therefore, a growth mindset intervention aims to change pupils' mindsets to the idea that intelligence is changeable in the hope that this improves academic behaviours and in turn academic attainment. An unpublished systematic literature review found some evidence to suggest that interventions promoting a growth mindset were effective at raising pupils' academic attainment, however, this was primarily true for pupils of educational disadvantage, or pupils who held a fixed mindset prior to the intervention (Kearney, 2016). This review provides an updated analysis of the effectiveness of growth mindset interventions on academic achievement. Following a systematic review of the literature, nine studies were evaluated using the Weight of Evidence Framework (Gough, 2007), and effect sizes were calculated, where possible, to help establish the effectiveness of the intervention. Findings suggest some evidence for growth mindset interventions increasing academic attainment; yet, this was only true for pupils at risk of educational disadvantage. However, the focus of the studies and their designs varied, therefore future research has been suggested which addresses the current research limitations.

Section 2: Introduction

What is a Growth Mindset?

Carol Dweck (2013) offers two theories of intelligence, the theory of fixed intelligence and the theory of malleable intelligence. Pupils who believe their intellect is innate and unchangeable hold an 'entity' view of intelligence, more commonly known as a 'fixed mindset'. On the other hand, those who have a 'growth mindset', believe their intelligence is changeable and can develop over time through practice, effort and instruction (Dweck, Walton & Cohen, 2011). This is also known as 'incremental' theory. Dweck (2013) notes that individuals with a growth mindset often attribute their performance to the effort they put into their work, rather than factors out of their control such as luck.

Psychological Theory

Growth mindset is grounded in Carol Dweck's Mindset theory, which illustrates that people have one of two mindsets, 'fixed' or a 'growth' mindset. According to this, the view people hold can affect how they learn (Dweck & Leggett, 1988). Mindset theory suggests that interventions promoting a growth mindset can help to change pupils' beliefs about the nature of their academic capability, providing pupils with the idea that their performance can improve with the amount of effort they put in. With this belief, pupils are more likely to engage in positive school behaviours and make an effort to succeed academically which can result in improved academic outcomes (Snipes & Tran, 2017; Farrington et al., 2012). In turn, this can produce a positive recursive cycle, whereby pupils' experiences of academic success strengthen their beliefs regarding the malleability of their ability and thus

reinforce their continued engagement in positive academic behaviours (Cohen, Garcia, Apfel & Master, 2006; Snipes, Fancsali & Stoker, 2012).

Pupils with a fixed mindset tend to avoid academically challenging situations, potentially hindering their success in school (Farrington et al., 2012). They want to look and feel smart. Therefore, they are more likely to choose performance goals that verify their intelligence instead of learning goals that aim to improve their intelligence (Mueller & Dweck, 1998). These students often perceive their failure as a lack of intelligence, eroding their self-efficacy and consequently display low levels of perseverance (Dweck, 2006). In contrast, pupils with a growth mindset tend to perceive failure as a lack of effort rather than their ability. They do not see challenge as a threat to one's ability, thus they are more likely to embrace the opportunity and show high levels of persistence and resilience as they recognise the value of effort and consider it necessary to develop and improve (Dweck, 2006). Consequently, holding a growth mindset predicts more learning than a fixed mindset (Blackwell, Trzesniewski & Dweck, 2007).

Growth Mindset Interventions

There are numerous ways that growth mindset interventions can be implemented. Previous research has involved teaching sessions on the brain and its plasticity, hearing about success stories and writing letters to future students about what they learned (Broughman & Kashubeck-West, 2017; Paunesku et al., 2015). Many growth mindset interventions now take place online, providing a cheaper and easier alternative than training staff (Dweck

& Yeager, 2019). Whilst growth mindset interventions can vary, there is at least one available intervention for schools to purchase, developed by Carol Dweck, this is called Brainology®. It is based on implicit theories of intelligence, helping pupils' to develop a growth mindset online. It teaches pupils about the plasticity of the brain, how the brain functions as well as providing practical strategies around how to apply this knowledge to schoolwork. The programme consists of an introduction and four half hour modules, as well as lesson resources for teachers to reinforce the ideas in the classroom.

Rationale and Relevance to EP Practice

The question regarding how children learn best has been considered for many centuries (Hattie, 2009), and is key to the EP role. Research and knowledge surrounding this area is continuously advancing and there is a need to find effective ways to apply theory to practice. However, it is also of utmost importance that these practices are evidence based and not based on hearsay. Lately, there has been growing interest surrounding the idea that the way individuals perceive themselves can ultimately affect their actions. Implicit theories of intelligence refer to whether an individual believes they can change their abilities and intelligence (Dweck, 2006). The way in which an individual performs can be affected by whether they hold a growth mindset, or whether they hold a fixed mindset. Research suggests that academic mindsets highly correlate with academic engagement and success in secondary and further education (Snipes & Tran, 2017). Interventions targeting academic mindsets have been shown to lead to improvements in

academic achievement (Dweck et al., 2011; Farrington et al., 2012; Yeager & Walton, 2011) and can even close the achievement gap (Dweck, 2013).

Therefore, it is important to determine whether growth mindset interventions are suitable for EPs to offer to schools with the aim of improving academic outcomes for children and young people.

Review Question: Are interventions promoting a growth mindset effective in raising academic achievement in school-aged pupils?

Section 3: Critical Review of the Evidence Base

Literature search

A literature search using three electronic databases relating to psychology and education was undertaken in January 2020. The three databases were:

- PsycINFO
- ERIC (ProQuest)
- Web of Science

Table 1

Database Search Terms

Search	Database Search Terms
1	"growth mindset" OR "academic mindset" OR "fixed mindset" OR "implicit inteligen*" OR "malleable intelligen*" OR "entity theory" OR "incremental theory" OR "personal conceptions of intelligence"
2	"academic performance" OR "achievement" OR "grade*" OR "level*" "scores" OR "attainment"
3	Intervention* OR experiment*

Note: asterix ()= wildcard search term*

Table 1 illustrates the terms used when searching. The initial search produced 160 results. Figure 1 shows a flowchart demonstrating the process of the literature search and where studies were excluded at each stage. Table 2 displays the inclusion and exclusion criteria by which the articles were assessed. Appendix 1 shows the studies included within this review, and Appendix 2 shows those that were excluded after full text inspection.

Figure 1

Flow Diagram of Literature Search

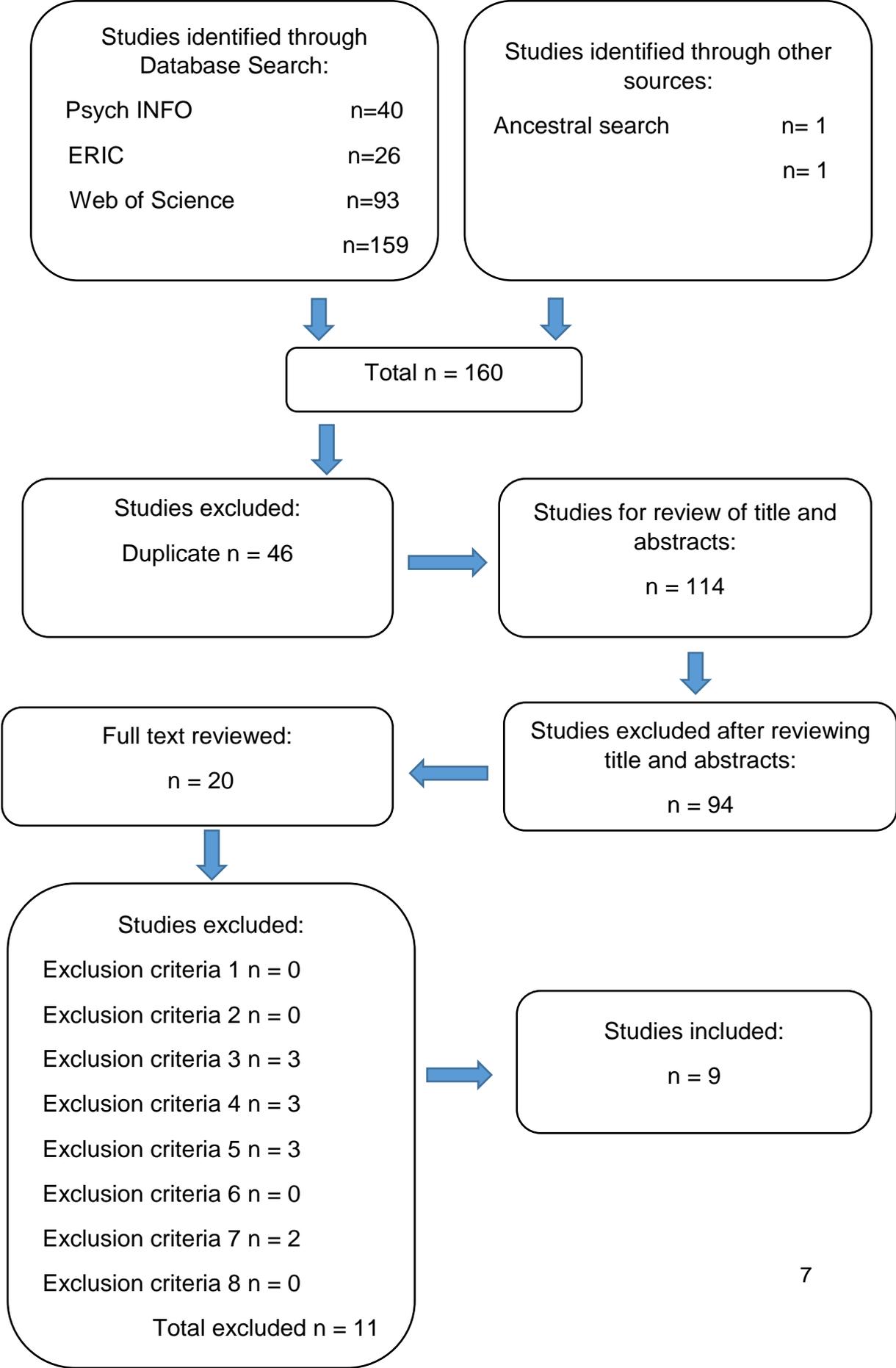


Table 2

Inclusion and Exclusion Criteria

Criteria	Inclusion Criteria	Exclusion Criteria	Rationale
1 Type of Publication	Peer-reviewed research only.	Non peer-reviewed research.	Increased credibility. They have undergone scrutiny ensuring minimum standard.
2 Date of publication	Studies published since 2015.	Studies published before 2015.	Prior systematic literature review published in 2015.
3 Intervention	Intervention promoting a growth mindset.	No intervention promoting a growth mindset.	Question aims to establish whether a growth mindset intervention can raise pupil attainment.
4 Design	Study uses original, primary, empirical quantitative data.	Study does not use original, primary empirical data or is a qualitative design.	Original data guarantees that all the articles have a unique dataset, thus reducing potential bias from the same dataset being analysed. Quantitative research enables a comparison of quantitative change to help addresses the review question around the effectiveness of the intervention on academic attainment.
5 Measures	Pre and post intervention data included for at least one outcome measure of academic attainment.	Pre or post intervention data not included for at least one outcome measure of academic attainment.	Helps to establish a direct measurement of the effectiveness of the intervention. The research question relates to raising pupil attainment.
6 Setting	Intervention delivered in an education setting.	Study based not in an education setting e.g. at home	To consider the implications of growth mindset interventions in education settings.

Criteria	Inclusion Criteria	Exclusion Criteria	Rationale
7 Participants	Participants are of school age (between 4 -18 years old).	Participants are not of school age (under 4 and over 18).	Statutory school aged pupils.
8 Geographical context and language	Any geographical context as long as study written in English.	Study not written in English.	Translation of articles not possible.

Weight of Evidence

Gough's (2007) Weight of Evidence (WoE) framework was used to evaluate all of the nine studies. This allowed for a systematic critical review, appraising the quality of the method (WoE A), the research design (WoE B) and how relevant the focus of the study was in relation to the current review question (WoE C). An overall score was produced for each study by calculating the three weightings and then dividing this by three (WoE D). Table 3 shows the WoE for each study.

WoE A was assessed using the Gersten et al. (2004) coding protocol which was amended to fit this review (See Appendix 4). In order to maintain consistency, all studies were coded using the same protocol. An example of a completed coding protocol can be found in Appendix 7. Following this, studies were appraised for methodological relevance, WoE B, using Guyatt et al.'s (1995) hierarchy of evidence and how relevant the studies were in relation to the current research question (WoE C). Details can be found in Appendix 5 and 6.

Table 3 *Weight of Evidence Ratings for all Studies*

Study	WoE A	WoE B	WoE C	WoE D
Bettinger et al. (2018)	High (3)	High (3)	Low (1)	Medium (2.3)
Brougham & Kashubeck-West (2017)	Medium (2)	High (3)	High (3)	High (2.7)
Burnette et al. (2018)	High (3)	High (3)	Medium (2)	High (2.7)
De Carvalho & Skipper (2019)	Low (1)	Low (1)	Low (1)	Low (1)
Orosz et al. (2017)	High (3)	Medium (2)	Low (1)	Medium (2)
Paunesku et al. (2015)	High (3)	High (3)	Medium (2)	High (2.7)
Rienzo et al. (2015) – Intervention 1	High (3)	High (3)	Medium (2)	High (2.7)
Yeager et al. (2016) – Study 2	Low (1)	Zero (0)	Low (1)	Low (0.7)
Yeager et al. (2019)	High (3)	High (3)	Medium (2)	High (2.7)

Note: < 1.6 (low), 1.7 – 2.3 (medium) and > 2.4 (high)

Participants

The nine studies in this review included a total 18,764 participants, ranging between 9 and 18 years. The studies took place in the UK (n=2), the US (n=5), Hungary (n=1) and Norway (n=1). Eight studies were conducted in secondary school settings, with only one being conducted in a primary school (Rienzo, Rolfe & Wilkinson, 2015). Most studies stated the proportion of male

and female pupils within each of the intervention and control groups, this was comparatively equal overall. All studies, except for two (Brougham & Kashubeck-West, 2017; Rienzo et al., 2015), targeted a subset of pupils, such as pupils considered 'at risk' or low achieving pupils. This is reflected in WoE C, where targeting a subset of pupils receives a lower score. Reporting on other demographics, such as ethnicity and socioeconomic status were described with most schools and participants coming from a range of backgrounds. Studies included participants from public, charter and private schools and ratings for WoE C take this into account. Pupils who are more likely to need support attend government-funded schools (Kratochwill, 2003), thus, private schools are not as representative of the target population. In Burnette et al. (2018) study, students were compensated for participation. This has not been taken into account in the weightings, however it is still considered important to note as this could have had an impact on the results as participants may have felt the need to report more positive answers when completing the questionnaires

Rates of attrition were low across five studies and high for three (Bettinger et al., 2018; Brougham & Kashubeck-West, 2017; Orosz et al., 2017), although Brougham & Kashubeck-West (2017) did state rates were comparable across conditions. Yeager et al. (2016) did not document attrition rates clearly, as they did not exclude any data, they estimated intent to treat effects. This is incorporated into scores for WoE A, with studies clearly documenting attrition rates scoring higher.

Study Design

Eight of the nine studies included in this review used a Randomised Controlled Trial design (RCT). RCTs scored higher in WoE B than other research designs as using a control group allows distinctions to be made between intervention effects and other confounding extraneous variables, thus increasing the internal validity. All of these studies used a control condition, offering participants a similar intervention, differing in content rather than a 'no intervention' control. In five of the studies, the control group focused on brain function and anatomy, whereas the remaining three studies received materials that were more unrelated such as the bystander effect (Orosz et al., 2017), safer sexual communication and decision skills (Burnette et al., 2018) and general study skills (Rienzo et al., 2015). Seven of the RCTs randomised participants at the individual level. This allows for bias to be controlled more effectively, reducing the impact of confounding variables. Orosz et al. (2017) randomly assigned participants at the group level allocating pre-existing classes to each condition. Whilst this is not weighted as highly as randomisation at the individual level in WoE B, it could be argued that it minimises contamination of the treatment to the control group. Researchers were blind to the study when involved in data collection in three studies (Rienzo et al., 2015; Yeager et al., 2016; Yeager et al., 2019), one using university trained research assistants and the other two utilising a third party to collect and clean the data. This is reflected in WoE A, with higher ratings where the researchers were blind to the study.

Each of the studies drew samples from at least two schools, except for Bettinger et al. (2019) and de Carvalho and Skipper (2019), which only

sampled one. Sampling from multiple schools allows the findings to be generalised more widely and thus is taken into account in WoE C. One study utilised a quasi-experimental design with a single group interrupted time series, thus consisting of no control group (de Carvalho & Skipper, 2019). This was therefore, scored lower for methodological relevance and design in WoE A and B.

Intervention

The intervention method and length varied between studies. They ranged from two sessions (Rienzo et al., 2015; Yeager et al., 2016; Yeager et al., 2019) up to ten sessions (de Carvalho & Skipper, 2019), and lasted between 25 minutes (Yeager et al., 2019) and 2 hours (Rienzo et al., 2015). All studies provided a description of the intervention, some describing it in more detail than others did. In Burnette et al. (2018) and Orosz et al. (2017) a detailed table of the intervention sessions were provided. Both of these studies were four and five sessions long respectively, with Burnette et al. (2018)'s intervention specifically relating to adolescent girls. Most of the interventions followed similar content and structure such as reading how the brain works, summarising key concepts, reading testimonials or thinking about personal experiences and writing a letter of encouragement to a future student (Bettinger et al., 2018; Brougham & Kashubeck-West, 2017; Paunesku et al., 2015; Yeager et al., 2016; Yeager et al., 2019). These interventions ran over two or three sessions. Writing a letter to a future student is considered a 'saying is believing' activity. This is thought to be effective as it makes the information more relevant to pupils, making it

potentially easier to recall (Bower & Gilligan; 1979; Hulleman & Harackiewicz, 2009).

Only one study ran for 10 sessions and they were embedded into the PSHE curriculum (de Carvalho & Skipper, 2019). This study loosely based its sessions on Blackwell, Trzeniewski and Dweck's (2007) workshops but a detailed description of the intervention is not included. The intervention was conducted in two parts; delivering the psychological content on the computer followed by a class activity and discussion. This study also focused on children with SEN which could be part of the reason why the sessions were much longer than the other studies and why it was also followed up by a class activity and discussion. Growth mindset strategies were also implemented during students' lessons, such as focusing on learning rather than performance goals. This could have affected the results of the intervention. One study consisted of sessions that lasted 2 hours (Rienzo et al., 2015). This comprised of mentoring and workshops around a growth mindset. Whilst a brief description of the intervention is given, it is not clear what is covered within each session. This study also implemented a further four-week course of workshops following the intervention and control group to allow for the identification of the impact of the mindset approach itself, outside of pupils spending time with mentors and external agencies.

Five of the interventions were delivered solely through a computer programme, with one intervention being implemented through a computer programme as well as being followed up with a class activity and discussion

with their teacher (de Carvalho & Skipper, 2019). The remaining three studies were delivered by a school counsellor (Brougham et al., 2017), trained teachers (Orosz et al., 2017) and trained university students (Rienzo et al., 2015). In Rienzo et al. (2015), the sessions were delivered by university students who were trained as project support assistants (PSAs). The students received training prior to delivering either the control or the treatment intervention in how to deliver the intervention, behaviour management as well as mindsets. In Orosz et al. (2017) teachers were trained for four hours and then implemented the sessions without further supervision. The majority of studies did not describe in detail how high fidelity had been achieved, apart from in three studies (Rienzo et al., 2015; Yeager et al., 2016; Yeager et al., 2019) where this had been achieved by the use of fidelity measures, fidelity checks and training. Perhaps this was due to the fact that the majority of studies were conducted online which raises the fidelity of implementation as it allows for more accurate replication of the intervention. The length and delivery of the intervention did not influence the WoE scores.

Measures

Most studies used Grade Point Average (GPA) for 'core' subjects, such as mathematics, English and science, as the academic attainment outcome measure. Yeager et al. (2019) suggests that GPA is a relevant outcome measure as it strongly predicts adult educational attainment and is generally understood to reflect motivation and prior knowledge. Rienzo et al. (2015) looked at mathematics and English scores, Burnette et al. (2018) used end of

year grades for all courses, whilst de Carvalho and Skipper (2019) only looked at reading paper scores. Studies that encompassed 'core' subjects such as maths, English and science as part of their academic attainment measure scored higher in WoE C. All studies consisted of pre and post measures, with two studies taking additional follow up measures (Orosz et al., 2017; Rienzo et al., 2015). However, both of these studies completed their 'immediate' post intervention measures three weeks and four months after the intervention respectively. Without immediate post data, it is more difficult to conclude whether it was the intervention or other factors that occurred in the time between that were responsible for any observed effects. Burnette et al. (2018) and de Carvalho and Skipper (2019) also include no immediate post scores for academic attainment measures, only including a post intervention measure at four months and seven weeks respectively.

Findings

Four studies reported a significant improvement in academic attainment after receiving a growth mindset intervention (Bettinger et al., 2018; Paunesku et al., 2015; Yeager et al., 2016; Yeager et al., 2019), but only for pupils who were previously low achieving. Where studies targeted a subset of pupils, such as students with low academic ability, they received a lower WoE C score. Rienzo et al. (2015) found no significant effect on maths or English; however, the effect size was considerably larger for the low pre-test subgroups than for the full sample. Most studies did not report an effect size to demonstrate the magnitude of improvement, either at all or specifically between growth mindset intervention and academic attainment. Therefore, where effect sizes were unknown, they were calculated using the mean

differences of groups within a pre-post control design (Morris, 2008) if possible. Table 4 reports the effect sizes. Yeager et al. (2016) only presented data for academic attainment with an interaction with prior achievement, thus an effect size was unable to be calculated. This resulted in a lower rating for WoE C as investigating the direct effect of intervention on academic attainment is more relevant to the current review question. All studies except one had small effect sizes, with Brougham and Kashubeck-West (2018), reporting a medium effect size, although change in GPA over time was slightly negative for the intervention group and positive for the control. This study suggested that the reason for this could be that the control lesson was more powerful than the mindset message, not being neutral enough for a control group reading. Orosz et al. (2017), Brougham and Kashubeck-West (2017), de Carvalho and Skipper (2019) and Burnette et al. (2018) found that whilst the intervention did not improve academic attainment, it did improve mindset beliefs, which have been shown to correlate with better grades (Blackwell et al., 2007; Paunesku, 2013). However, only Burnette et al. (2018) found effects were sustained at follow up.

Limitations

All of the studies only lasted for a short duration, the maximum length being ten months including follow up measures (Rienzo et al. 2015). However, developing a growth mindset can affect academic behaviour over time (Yeager & Dweck, 2012), with Blackwell et al. (2007) reporting positive grade results occurring over two years. In addition to this, most studies had a small

sample size and therefore did not have sufficient power, thus a larger sample size may have led to statistically significant results. The statistical power of the studies was stated in the majority of the studies as a limitation and an area for future development. Furthermore, whilst studies tried to limit demand characteristics, there is a possibility that pupils may have spoken about the materials used in the sessions. This contamination is problematic as it makes it difficult to differentiate and can introduce bias, decrease effect size estimates and reduce power (Keogh-Brown, et al., 2007). De Carvalho and Skipper (2019) did not have a control group and therefore it is not possible to isolate the effects of the treatment group from the influence of confounding variables. This has been taken into account in all of their WoE scores, resulting in a lower rating. For some of the studies, academic attainment was a secondary focus and they did not include information on whether it was statistically significant. This made it more difficult to determine the change in outcomes and differences between groups. Where this change was unobservable, studies received a lower WoE C score. Some of the interventions were also multifaceted; making it difficult to know which element drove which effect. Finally, three of the studies were conducted with Carol Dweck, raising the possibility that the researchers may have unconsciously been subject to experimenter bias as they would have had a vested interest in finding results that are more favourable.

Table 4

Effect Sizes and Descriptors

Study	Sample Size	Outcome Measure	Effect Size	Descriptor	Overall WoE D
Bettinger et al. (2018)	254	Grade Point Average	d= 0.081	Small	Medium (2.3)
Brougham & Kashubeck-West (2017)	69	Grade Point Average	d=0.7031	Medium	High (2.7)
Burnette et al. (2018)	222	Mean final Grades	d= -0.027	Small	High (2.7)
De Carvalho & Skipper (2019)	18	Reading paper examination score	d= 0.1636	Small	Low (1)
Orosz et al. (2017)	55	Grade Point Average	d=0.3517	Small	Medium (2)
Paunesku et al. (2015)		Grade Point Average	d=0.21 (‘at risk’ pupils only) <small>Not enough information to calculate effect size of intervention on GPA without interaction of ‘at risk’</small>	Small	High (2.7)

Study	Sample Size	Outcome Measure	Effect Size	Descriptor	Overall WoE D
Rienzo, Rolfe & Wilkinson (2015)	286	Maths scores	d = 0.10	Small	High (2.7)
Yeager et al. (2016) – Study 2	3676	English scores	d = 0.18	Small	Low (0.7)
		Grade Point Average	Not enough information to calculate effect size without interaction of prior achievement.	N/A	
Yeager et al. (2019)	12,490	Grade Point Average	d = 0.0679	Small	High (2.7)

Note: Cohen's d (1988) descriptors: 0.2(small), 0.5 (medium) and 0.8(large). WoE D: < 1.6 (low), 1.7 – 2.3 (medium) and > 2.4 (high)

Section 4: Conclusions and Recommendations

This systematic literature review examined the effectiveness of growth mindset interventions in raising academic attainment. Whilst some studies found that participants benefited from a growth mindset intervention, the benefits were only for specific groups of pupils, either considered to be 'at risk' or low achieving. Therefore, this evidence suggests that growth mindset interventions are effective at raising academic attainment in certain subgroups of pupils. This supports conclusions drawn by Kearney (2016). Nevertheless, some studies found that a growth mindset intervention improved mindset beliefs, which has previously been shown to correlate with better grades (Blackwell et al., 2007; Paunesku, 2013; Claro, Paunesku & Dweck, 2016). Although, only one study found that this was sustained after follow up (Burnette et al., 2018), suggesting that mindsets can change quickly. Dommett, Devonshire, Sewter, et al. (2013) state that mindsets can adjust quickly throughout an intervention but can rapidly return to their preliminary level when the growth mindset message is no longer present, consequently, this emphasises the need for a growth mindset intervention to be embedded into the whole school culture and environment and within every lesson (Yeager & Walton, 2011).

In terms of EP practice, the findings from this review suggests that whilst growth mindset interventions do not seem to improve the academic attainment of pupils universally, they may be able to raise attainment for pupils considered at risk of educational disadvantage. However, the

evidence-base considered within this review contains some methodological weaknesses and some of the studies were not entirely relevant to the current review question. Consequently, the findings need to be interpreted cautiously. Growth mindset interventions may need to be offered to schools thoughtfully, explaining the potential advantages and pitfalls as well as being carefully monitored against intended outcomes. If schools can improve pupils' academic performance, especially amongst the lowest achieving pupils, with growth mindset interventions, they can offer a low cost, easy implementable option for schools. Therefore, more research is needed in order to determine the effectiveness of growth mindset interventions on raising academic attainment.

Recommendations

Further research could address some of the limitations to the designs of the studies reviewed. For example, many of the studies consisted of a small sample size, thus, higher-powered studies with more participants are necessary to allow conclusions to be drawn more confidently. In addition to this, studies should evaluate results for a longer duration to see whether the effects are maintained over time. Research should also investigate the specific links between the intervention and academic attainment as well as the interaction between changing mindsets and academic achievement. Furthermore, it may be helpful to investigate the impact of a growth mindset intervention when embedded into the whole school culture and environment to determine whether this has more of an impact.

It is also important to note that there are issues around generalisability of findings. Only one study took place in a primary school, thus further research is needed in this area to determine whether a growth mindset intervention would be effective for this younger age group. Additionally, only two studies took place within the UK, with the majority conducted within the US and two studies conducted in a region where the education system is less likely to be comparable. Therefore, generalising these findings to the UK need to be done with care, and more research is needed to establish the effectiveness of growth mindset interventions within the UK.

References

- Bettinger, E., Ludvigsen, S., Rege, M., Solli, I. F., & Yeager, D. (2018). Increasing perseverance in math: Evidence from a field experiment in Norway. *Journal of Economic Behavior & Organization*, *146*, 1–15.
- Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*(1), 246-263.
- Bower, G. H., & Gilligan, S. G. (1979). Remembering information related to one's self. *Journal of research in personality*, *13*(4), 420-432.
- Brougham, L., & Kashubeck-West, S. (2017). Impact of a growth mindset intervention on academic performance of students at two urban high schools. *Professional School Counseling*, *21*(1).
- Burnette, J. L., Russell, M. V, Hoyt, C. L., Orvidas, K., & Widman, L. (2018). An Online Growth Mindset Intervention in a Sample of Rural Adolescent Girls. *British Journal of Educational Psychology*, *88*(3), 428–445.
- Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. *Proceedings of the National Academy of Sciences*, *113*(31), 8664-8668.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.

- Cohen, G. L., Garcia, J., Apfel, N., & Master, A. (2006). Reducing the racial achievement gap: A social-psychological intervention. *Science*, 313 (5791), 1307–1310.
- de Carvalho, E., & Skipper, Y. (2019). A two-component growth mindset intervention for young people with SEND. *Journal of Research in Special Educational Needs*.
- Dommett, E. J., Devonshire, I. M., Sewter, E., & Greenfield, S. A. (2013). The impact of participation in a neuroscience course on motivational measures and academic performance. *Trends in Neuroscience and Education*, 2(3-4), 122-138.
- Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.
- Dweck, C. S. (2013). *Self-theories: Their Role in Motivation, Personality, and development*. Psychology press.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological review*, 95(2), 256.
- Dweck, C., Walton, G. M., & Cohen, G. L. (2011). Academic tenacity: Mindset and skills that promote long-term learning. *Gates Foundation. Seattle, WA: Bill & Melinda Gates Foundation*, 1–43. Retrieved from http://web.stanford.edu/~gwalton/home/Welcome_files/DweckWaltonCohen_2014.pdf

- Dweck, C. S., & Yeager, D. S. (2019). Mindsets: A View From Two Eras. *Perspectives on Psychological Science : A Journal of the Association for Psychological Science*, 14(3), 481–496.
- Farrington, C. A, Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T. S., Johnson, D. W., & Beechum, N. O. (2012). The role of noncognitive factors in shaping school performance : A critical literature review. *Teaching Adolescents To Become Learners*, N.O. (June), 108.
- Gough, D. (2007). Weight of Evidence: a framework for the appraisal of the quality and relevance of evidence. *Research Papers in Education*, 22(2), 213-228.
- Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C, & Innocenti, M. (2004). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, 71,149-164
- Guyatt, G. H., Sackett, D. L., Sinclair, J. C., Hayward, R., Cook, D, J., & Cook, R. J. (1995). Users' Guides to the Medical Literature: IX. A Method for Grading Health Care Recommendations. *The Journal of the American Medical Association*, 274(22), 1800–1804.
- Hattie, J. (2009). *Visible learning: A synthesis of over 800 metaanalyses relating to achievement*. New York, NY: Routledge.
- Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *Science*, 326, 1410–1412.

- Kearney, T. (2016). Are school-based interventions that promote a growth mindset effective in raising pupil attainment? An evidence-based practice report. Submitted as part of the Doctorate in Educational and Child Psychology. London; University College London.
- Keogh-Brown, M. R., Bachmann, M. O., Shepstone, L., Hewitt, C., Howe, A., Ramsay, C. R., & Elbourne, D. R. (2007). Contamination in Trials of Educational Interventions. *Health Technology Assessment*, 11 (43): 1 – 127.
- Kratochwill, T. R. (2003). Task Force on Evidence-Based Interventions in School Psychology. Retrieved January 15, 2020, from http://www.indiana.edu/~ebi/documents/_workingfiles/EBImanual1.pdf
- Morris, S. B. (2008). Estimating Effect Sizes From Pretest-Posttest-Control Group Designs. *Organizational Research Methods*, 11 (2), 364-386.
- Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology*, 75, 33–52.
- Orosz, G., Péter-Szarka, S., Bóthe, B., Tóth-Király, I., & Berger, R. (2017). How Not to Do a Mindset Intervention: Learning from a Mindset Intervention among Students with Good Grades. *Frontiers in Psychology*, 8.
- Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science*, 26(6), 784–793.

Rienzo, C., Rolfe, H., & Wilkinson, D. (2015). *Changing Mindsets: Evaluation Report and Executive Summary*. Retrieved from Education Endowment Foundation.

Snipes, J., Fancsali, C., & Stoker, G. (2012). *Student academic mindset interventions – A review of the current landscape*. San Francisco, CA: Stupski Foundation.

Snipes, J., & Tran, L. (2017). Growth mindset, performance avoidance, and academic behaviors in Clark County School District. *Regional Educational Laboratory at West Ed*, 2017-226.

Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, 573(7774), 364+.

Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C., Dweck, C. S. (2016). Using Design Thinking to Improve Psychological Interventions: The Case of the Growth Mindset during the Transition to High School. *Journal of Educational Psychology*, 108(3), 374–391.

Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, 81, 267–301.

Appendices**Appendix 1: List of Included Studies**

 Full Reference

1. Bettinger, E., Ludvigsen, S., Rege, M., Solli, I. F., & Yeager, D. (2018). Increasing perseverance in math: Evidence from a field experiment in Norway. *Journal of Economic Behavior & Organization, 146*, 1–15.
 2. Brougham, L., & Kashubeck-West, S. (2017). Impact of a growth mindset intervention on academic performance of students at two urban high schools. *Professional School Counseling, 21*(1).
 3. Burnette, J. L., Russell, M. V, Hoyt, C. L., Orvidas, K., & Widman, L. (2018). An Online Growth Mindset Intervention in a Sample of Rural Adolescent Girls. *British Journal of Educational Psychology, 88*(3), 428–445.
 4. de Carvalho, E., & Skipper, Y. (2019). A two-component growth mindset intervention for young people with SEND. *Journal of Research in Special Educational Needs*.
 5. Orosz, G., Péter-Szarka, S., Bőthe, B., Tóth-Király, I., & Berger, R. (2017). How Not to Do a Mindset Intervention: Learning from a Mindset Intervention among Students with Good Grades. *Frontiers in Psychology, 8*.
 6. Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science, 26*(6), 784–793.
 7. Rienzo, C., Rolfe, H., & Wilkinson, D. (2015). *Changing Mindsets: Evaluation Report and Executive Summary*. Retrieved from Education Endowment Foundation.
 - Intervention 1
 8. Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C., Dweck, C. S. (2016). Using Design Thinking to Improve Psychological Interventions: The Case of the Growth Mindset during the Transition to High School. *Journal of Educational Psychology, 108*(3), 374–391.
 - Study 2
-

-
9. Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, 573(7774), 364+.
-

Appendix 2: List of Studies Excluded at Full Text Screening

Study	Reason for Exclusion (criteria number)
Bedford, S. (2017). Growth mindset and motivation: a study into secondary school science learning. <i>RESEARCH PAPERS IN EDUCATION</i> , 32(4, SI), 424–443.	No academic attainment outcome measure (5).
Bostwick, K. C. P., Collie, R. J., Martin, A. J., & Durksen, T. L. (2017). Students’ growth mindsets, goals, and academic outcomes in mathematics. <i>Special Issue: Implicit Theories: The Role and Impact of Malleable Mindsets</i> , 225(2), 107–116.	No intervention (3).
Burgoyne, A. P., Hambrick, D. Z., Moser, J. S., & Burt, S. A. (2018). Analysis of a mindset intervention. <i>Journal of Research in Personality</i> , 77, 21–30.	Participants not of school age (7).
Chao, M. M., Visaria, S., Mukhopadhyay, A., & Dehejia, R. (2017). Do Rewards Reinforce the Growth Mindset?: Joint Effects of the Growth Mindset and Incentive Schemes in a Field Intervention. <i>Journal of Experimental Psychology-General</i> , 146(10), 1402–1419.	No academic attainment outcome measure (5).
Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 113(31), 8664–8668.	No intervention (3).
Cook, D. A., Gas, B. L., Farley, D. R., Lineberry, M., Naik, N. D., Lara, F. J. C., & Artino Jr., A. R. (2019). Influencing Mindsets and Motivation in Procedural Skills Learning: Two Randomized Studies. <i>Journal of Surgical Education</i> , 76(3), 652–663.	No academic attainment outcome measure (5).
Destin, M., Hanselman, P., Buontempo, J., Tipton, E., & Yeager, D. S. (2019). Do Student Mindsets Differ by Socioeconomic Status and Explain Disparities in Academic Achievement in the United States? <i>Aera Open</i> , 5(3).	Does not use primary, empirical data (4).
Dixon, D. D., Roberson, C. C. B., & Worrell, F. C. (2017). Psychosocial Keys to African American Achievement? Examining the Relationship between Achievement and Psychosocial Variables in High Achieving African Americans. <i>Journal of Advanced Academics</i> , 28(2), 120–140.	No intervention (3).
Hoyert, M. S., Ballard, K., & O’Dell, C. D. (2019). Increasing Student Success through a Cocktail of	Participants not of school age (7).

Study	Reason for Exclusion (criteria number)
Cognitive Interventions. <i>Journal of the Scholarship of Teaching and Learning</i> , 19(1), 128–134.	
Miller, D. I. (2019). When Do Growth Mindset Interventions Work? <i>Trends in Cognitive Sciences</i> , 23(11), 910–912.	Does not use primary, empirical data (4) .
Verberg, F. L. M., Helmond, P., & Overbeek Fenneke L. M.; ORCID: http://orcid.org/0000-0001-6809-2982 , G. A. I.-O. http://orcid.org/Verber . (2018). Study protocol: A randomized controlled trial testing the effectiveness of an online mindset intervention in adolescents with intellectual disabilities. <i>BMC Psychiatry</i> , 18.	Study protocol – study not yet been implemented/reported (4).

Note. Studies included here underwent full text inspection. Studies that were excluded at the title and abstract screening are not included here.

Appendix 3: Mapping the Field

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
Bettinger et al. (2018)	To investigate whether improving pupils mindsets can increase their perseverance in maths.	Experimental design.	Norway	Norwegian first year high school pupils.	Three online sessions, 45 minutes.	GPA and maths grade	Treatment effects on student's perseverance and academic performance in maths
		Random allocation by computer programme..		First year high school starts around 16 years old.	Based on Yeager et al. (2016) - adapted to the Norwegian language, culture and context. Session 1 and 2 - Read article, summarised and wrote advice to friend struggling.	Data presented for GPA after each session.	
		Pre and post measures.		Participation mandatory - school instruction. Participant numbers unclear. Session 1 = 354 Session 2 = 289 Session 3 = 254 Absence high in Norway.	Session 3 - real effort task. Students have to solve a series of algebra questions. Control – similar design, about the brain		
	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
Brougham & Kashubeck-West (2017)	To improve academic performance and attendance rates by developing a growth mindset	Experimental study.	US	69 urban high school students from two high schools.	3-session mindset intervention. Started fifth week into the semester. Conducted by school counsellor.	GPA (mathematics, science, communication arts, and social studies)	No improvement on GPA. Improved mindset beliefs. Change in GPA over time was positive for the control group and slightly negative for treatment group.
		Randomly assigned by random number generator.		RHMS – an academically rigorous magnet high school THS – a traditional high school Freshmen population.	<u>Session 1:</u> pupils read how the brain works, briefly summarizing six key concepts. <u>Session 2:</u> read story about a pupil who struggled but improved with effort.	Pre measure, after Semester 1 Post intervention, after the completion of Semester 2.	

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
		Participants from two schools. 2x2 design School (RHMS or THS) with treatment (yes or no) Pre and post measures.		43 female, 26 male. 45 identified as Black 18 as White 5 as Asian 1 as Hispanic. RMHS – 42% free and reduced lunches THS – 85% free and reduced lunches 23 attended THS; 11 in treatment group. 46 attended RMHS; 23 in treatment group.	<u>Session 3</u> : students wrote letter of encouragement to future student. Control: paralleled the treatment sessions, only content differed. Control sessions were about brain anatomy and physiology.		
Burnette et al. (2018)	To see whether an online growth mindset intervention could promote academic success.	Randomised controlled trial. Pre-test, immediate post-test and four-month follow-up.	US – southeast	222 10th-grade adolescent girls Four rural, low-income high schools Intervention=115 Control = 107	Online growth mindset intervention – Project Growing Minds - consisted of four modules. The first module involved an introduction and the others covered intelligence mindsets, person mindsets and self-regulation mindsets. Each module contained four parts: 1) Related research 2) Standard growth mindset message 3) Incorporated a role model delivering tips for success	9 th and 10 th grade - mean final grades calculated for each year. Pre intervention and delayed post intervention follow up for GPA (4 months later). No immediate post intervention data.	Grades did not improve following the intervention.

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
					<p>4) 'saying is believing' exercise to adopts the growth mindset message</p> <p>Each session was 45 minutes.</p> <p>Control: Attention matched online intervention - HEART (Health Education and Relationship Training) on safer sexual communication and decision-making skills. Consisted of 5 modules, also lasting 45 minutes.</p> <p>Students were compensated for their participation.</p>		
De Carvalho & Skipper (2019)	To investigate an intervention promoting growth mindset with young people with SEND.	<p>Quasi-experimental intervention.</p> <p>Single group interrupted time series design.</p> <p>Single condition, no control group.</p> <p>Pre, post and delayed post</p>	UK	<p>18 pupils with SEND</p> <p>Ages 14 – 16</p> <p>9 males</p> <p>Secondary school for children and young people with SEND</p>	<p>10-week intervention</p> <p>Ten 50 minute lessons, once a week.</p> <p>Adapted and embedded into PHSE curriculum. Psychological content delivered online. Content supported with classroom activities and discussion.</p> <p>Each lesson focused on a different area of growth mindset and followed the same structure each session.</p> <p>English lessons were also adapted to implement growth mindset strategies.</p>	<p>Half-termly reading paper</p> <p>Also looked at measure 11 weeks pre intervention.</p> <p>No immediate post measure for GPA, only delayed post 7 weeks later.</p>	<p>No improvement in academic performance</p> <p>Greater change towards a growth mindset was related to less progress.</p>

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
		measures conducted.					
Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
Orosz et al.(2017)	To examine effectiveness of a Growth Mindset intervention in the Hungarian educational context.	A cluster randomised controlled trial. Pupils randomised by class. Pre, post and delayed post measure.	Hungary	55 Hungarian 10 th grade pupils with high GPA from 2 schools in countryside. Aged 15 – 18 years. Intervention group : 26 pupils (11 female) Control group: 29 pupils (18 female)	Train the trainer intervention. One of the authors trained the teachers (randomly assigned) over 4 hours. Teachers implemented without further supervision. Spring term. 5 weeks, 1 x per week. 5 x 45 minute sessions. Intervention – focus on everyday aspects of incremental theory of brain rather than functioning of brain. Neuroplasticity emphasised in session 3. Control – similar intervention, focused on bystander effects. Details of each of the sessions included in the intervention and control group are included in the study.	All measures translated to Hungarian. GPA data was available from the school’s electronic diary. Average GPA was calculated. Pre - 1 week before Post 1 - 3 weeks after intervention Post 2 - 4 months after	GPA did not improve following intervention
Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
Paunesku et al. (2015)	To see whether a growth mindset and sense of	RCT Individually randomly assigned.	US (eastern , western and	1594 pupils in 13 geographically diverse high schools	Control group and three interventions: 1. Control 2. Growth mindset 3. Sense of purpose 4. Two interventions combined	GPA in core academic courses – gathered pre and post intervention.	Growth mindset intervention and ‘at risk pupils’ produced a significant interaction and

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
	purpose intervention could raise achievement.	Control and three interventions.	south western)	8 public schools, 4 charter schools, 1 private school.	<p>Session 1 – growth mindset intervention (or related control materials)</p> <p>Session 2 – the sense of purpose intervention (or related control materials)</p> <p>All pupils took part in both sessions.</p> <p>Growth mindset intervention involved reading an article and two writing exercises applying their knowledge – one summarising and one providing advice to hypothetical student.</p> <p>Control condition completed similar materials but different content, focusing on brain function rather than neural plasticity.</p>		<p>non-significant for the combined intervention.</p> <p>Interventions most beneficial for poorly performing pupils - each intervention raised semester GPA in core academic courses.</p>
Rienzo, Rolfe & Wilkinson (2015) – Intervention 1	To improve academic attainment by supporting pupils to develop a growth mindset.	Randomised controlled trial. Intervention and active control group. Pre, post and delayed post measures.	UK	6 schools Year 5 pupils N = 286 Intervention = 144 Control = 142	<p>Intervention: Six weeks mentoring and workshops focusing on growth mindsets Each session = 2 hours.</p> <p>Sessions included an introduction to growth/fixe mindsets, types of language, spelling and maths tasks (teaching that finding right strategies helps) , hard work, effort and practice as well as a concluding session.</p>	<p>Attainment of year 5 English and Maths scores.</p> <p>Progress in English (PiE) and Measuring Success in Maths (MSiM) tests.</p> <p>PiE examines spelling, grammar and reading comprehension.</p>	<p>Intervention group made average of two additional months progress in English and Maths.</p> <p>Findings not statistically significant.</p>

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
					<p>Control: Received same amount of extra support with study skills, with a focus on general study skills.</p> <p>Trained university students, employed as project support assistants, delivered both the control and intervention groups.</p> <p>Workshops delivered to 15 pupils at a time. Teachers not present unless pupil needed specialist support. Both intervention and control groups received another four week course of workshops following initial intervention.</p>	<p>Baseline test : before the start of the intervention</p> <p>Immediate post-test : four months after</p> <p>Delayed post-test :ten months after</p>	<p>Findings close to statistical significance for English.</p>
Yeager et al. (2016) – Study 2	To examine whether a redesigned growth mindset intervention can improve grades of 9 th graders	National convenience sample. Randomly assigned by software.	US	<p>N = 3676</p> <p>10 Public high schools 9th grade</p> <p>48% female</p> <p>52% stated that their mother had a Bachelor’s degree or higher</p>	<p>Two one-period online sessions at school during lessons.</p> <p>Sessions 1-4 weeks apart. Began in the first 10 weeks.</p> <p>Teachers read a script to pupils at the start of each computer session.</p> <p>Intervention activity was revised mindset intervention from study 1.</p> <p>Pupils read an article about the brain, asked to think of a personal example and write a letter to a future student.</p>	<p>Ninth grade GPA scores collected at end of semester 1.</p> <p>Grades converted to a 0 – 4.33 scale. End of term grades for the core subjects were averaged.</p> <p>Pre intervention 8th grade GPA scores and test scores were looked at.</p> <p>Results looked at interaction between prior achievement and growth</p>	<p>Revised intervention more effective in changing beliefs and short term behaviours.</p> <p>Intervention increased grades for previously low-achieving students.</p>

Author	Aim	Study Design	Location	Participants	Intervention Details	Key Outcome Measures	Key Findings
					Control activity similar. Included basic information about the brain as well as different stories from celebrities.	mindset with GPA, not solely at growth mindset and GPA. Third party research firm collected and cleaned data.	
Yeager et al. (2019)	To examine effects of growth mindset intervention on lower achieving pupils	Randomised condition within schools. Pre and post measures.	US	65 schools N = 12, 490 ninth grade pupils N = 6320 lower achieving pupils relative to peers 29% reported mother had a bachelor's degree or higher	Short online growth mindset intervention. Session 1 – basic idea of growth mindset Session 2 –deepen pupils knowledge of growth mindset and application to their lives 2 self-administered sessions. 25minutes long. During schools hours Approx. 10 days between each session Control condition focused on brain functions. Similar to intervention but did not address intelligence beliefs. Delivered as early in school year as possible.	GPA (maths, science, English or language arts and social studies) Obtained from school admin. Analysis focused on lower achieving subgroup.	Intervention improved GPAs of lower achieving pupils in core classes

Appendix 4: Weight of Evidence A

Gersten et al. (2004) coding protocol was utilised to help code each of the studies, generating a WoE A rating. The first question of the protocol was adapted to fit this review as the original question was designed for a SEN population.

Table 1. Criteria for WoE A

WoE A Rating	Criteria
3 (High)	<ol style="list-style-type: none"> 1. Study meets at least 9 essential criteria 2. Study meets four or more desirable criteria
2 (Medium)	<ol style="list-style-type: none"> 1. Study meets at least 9 essential criteria 2. Study meets at least 1 and less than 4 desirable criteria
1 (Low)	<ol style="list-style-type: none"> 1. Study meets at least 9 essential criteria

Table 2. Summary of WoE A for all studies

Study	Number of essential criteria	Number of desirable criteria	WoE A
Bettinger et al. (2018)	9	4	High (3)
Brougham & Kashubeck-West (2017)	9	3	Medium (2)
Burnette et al. (2018)	9	5	High (3)
De Carvalho & Skipper (2019)	6	3	Low (1)
Orosz et al. (2017)	9	5	High (3)
Paunesku et al. (2015)	10	4	High (3)

Study	Number of essential criteria	Number of desirable criteria	WoE A
Rienzo et al. (2015) – Intervention 1	9	6	High (3)
Yeager et al. (2016) – Study 2	8	5	Low (1)
Yeager et al. (2019)	9	6	High (3)

Appendix 5 : Weight of Evidence B

WoE B is a review-specific judgement, examining the relevance of the study’s research design in answering the current review question. Criteria for WoE B judgements are derived from evidence hierarchies, identifying Randomised Controlled Trials (RCTs) as the most robust design for answering a question based on effectiveness (Guyatt et al., 1995).

Table 1. Criteria for WoE B

WoE B Rating	Criteria
High (3)	<ul style="list-style-type: none"> • Random allocation of participants to condition(at individual level) • Includes at least one control/comparison group • Pre and post data collected for relevant measure for all groups (academic attainment)
Medium (2)	<ul style="list-style-type: none"> • Random allocation of participants to condition (can occur at group level eg. class) • Includes at least one control/comparison group • Pre and post data collected for relevant measure for all groups (academic attainment)
Low (1)	<ul style="list-style-type: none"> • Qualitative research, surveys, non-experimental evaluations and case-control studies • No control/comparison group • Pre and post data collected for relevant measure (academic attainment)
Zero (0)	<ul style="list-style-type: none"> • The study does not meet any of the criteria

Note. Criteria is based on “typology of evidence” where recommendations for studying the effectiveness of interventions are provided (Petticrew and Roberts, 2003).

Table 2. Rationale for WoE B

Criteria	Rationale
Random Allocation	Minimises between participant differences, reducing the possibility for bias in the sample and the influence of any confounding variables. Random allocation is stronger at an individual level rather than at a group level.
Use of control group	A control group allows comparisons to be made between changes in an intervention group with a group who have not had access to the intervention allowing the analysis of an intervention effect.
Reporting of results	Pre and post measures allow for an analysis of change within the participants to be assessed in relation to the intervention.

Table 3. Scores for WoE B

Study	Overall WoE B
Bettinger et al. (2018)	High (3)
Brougham & Kashubeck-West (2017)	High (3)
Burnette et al. (2018)	High (3)
De Carvalho & Skipper (2019)	Low (1)
Orosz et al. (2017)	Medium (2)
Paunesku et al. (2015)	High (3)
Rienzo et al. (2015) – Intervention 1	High (3)
Yeager et al. (2016) – Study 2	Zero (0)
Yeager et al. (2019)	High (3)

Appendix 6: Weight of Evidence C

WoE C evaluates a study based on its relevance in answering the review question (Gough, 2007). Therefore, within this review, it is evaluating the extent to which an intervention promoting a growth mindset is effective in increasing academic attainment in school-aged children. For a study to receive a rating, all criteria for that rating must be met.

Table 1. Criteria for WoE C

WoE C Rating	Criteria
High (3)	<ul style="list-style-type: none"> • Study takes place with a comparable education system and language instruction is English (e.g. US, Canada, Australia, New Zealand). • Participants from more than one school • Intervention targets all children • Academic attainment measure covers ‘core’ subjects (Maths, English and Science) • Study investigates the direct effect of the intervention on academic achievement
Medium (2)	<ul style="list-style-type: none"> • Study takes place with a comparable education system and language instruction is English (e.g. US, Canada, Australia, New Zealand). • Participants from only one school • Intervention targets a subset of pupils (e.g. pupils identified as ‘at-risk’, pupils with SEN, gender, pupils with high or low academic ability) • Academic attainment measure contains at least two different subjects
Low (1)	<ul style="list-style-type: none"> • Study conducted in country with a different education system • Academic attainment measure only covers one subject or not specifically stated • Study investigates the effects of the intervention on academic achievement as moderated by other variables
Zero (0)	<ul style="list-style-type: none"> • Study meets none of the criteria above

Table 2. Rationale for WoE C

Criteria	Rationale
Location – study takes place with a comparable education system	To be able to generalise study findings and see the intervention effectiveness in England and its education system.
Participants – sampled from more than one school	If sample covers multiple schools, findings can be generalised more widely.
Intervention – universal and targets all children	The research question looks at raising attainment generally, rather than for a specific population of pupils.
Outcome measure - academic attainment measure covering all 'core' subjects	Covering core subjects makes it more relevant to answering the question relating to academic attainment and makes it more generalisable than a measure for one subject.
Data analysis – investigates direct effect of intervention on academic achievement	Analysis investigating direct effect of intervention and academic outcome measure is more relevant to the current review question.

Table 3. Scores for WoE C

Study	Overall WoE C
Bettinger et al. (2018)	Low (1)
Brougham & Kashubeck-West (2017)	High (3)
Burnette et al. (2018)	Medium (2)
De Carvalho & Skipper (2019)	Low (1)
Orosz et al. (2017)	Low (1)
Paunesku et al. (2015)	Medium (2)
Rienzo et al. (2015) - Intervention 1	Medium (2)
Yeager et al. (2016) – Study 2	Low (1)
Yeager et al. (2019)	Medium (2)

Appendix 7: Coding Protocols

Coding protocol: Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C, & Innocenti, M. (2004). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, 71, 149-164.

Study: Bettinger et al. (2018)

Essential Quality Indicators - Quality indicators for describing participants

~~Was sufficient information provided to determine/confirm whether the participants demonstrated the disability(ies) or difficulties presented?~~

~~Yes~~

~~No~~

~~N/A~~

~~Unknown/Unable to Code~~

Was sufficient information provided in order to identify the population of participants to which results may be generalised?

Yes (although not clearly stated in the 'sample' section)

No

N/A

Unknown/Unable to Code

Total size of sample : unclear - S1 = 354, S2 = 289, S3 = 254

Intervention group sample size: unknown

Control group sample size: unknown

Were appropriate procedures used to increase the likelihood that relevant characteristics of participants in the sample were comparable across conditions?

Yes – randomly allocated by computer programme

No

N/A

Unknown/Unable to Code

Was sufficient information given characterizing the interventionists or teachers provided? Did it indicate whether they were comparable across conditions?

Yes – computer programme for both conditions

No

N/A

Unknown/Unable to Code

Essential Quality Indicators - Quality indicators for Implementation of the Intervention and Description of Comparison Conditions

Was the intervention clearly described and specified?

Yes

No

N/A

Unknown/Unable to Code

Was the fidelity of implementation described and assessed?

Yes – researcher team administered protocol with teacher present for sessions 1 and 2, teachers implemented session 3 with a script but research team present if needed and conducted through computer programme.

No

N/A

Unknown/Unable to Code

Was the nature of services provided in comparison conditions described?

Yes

No

N/A

Unknown/Unable to Code

Essential Quality Indicators – Quality Indicators for Outcome Measures

Were multiple measures used to provide an appropriate balance between measures closely aligned with the intervention and measures of generalised performance?

Yes – GPA, maths grade and mindset measures

No

N/A

Unknown/Unable to Code

Were outcomes for capturing the intervention's effect measured at the appropriate times?

Yes

No

N/A

Unknown/Unable to Code - unclear exactly when GPA is measured.

Essential Quality Indicators – Quality Indicators for Data Analysis

Were the data analysis techniques appropriately linked to key research questions and hypotheses? Were they appropriately linked to the limit of analysis in the study?

Yes

No

N/A

Unknown/Unable to Code

Did the research report include not only inferential statistics but also effect size calculations?

Yes

No

N/A

Unknown/Unable to Code

Essential Quality Indicators Total Score: 9

Desirable Quality Indicators

Was data available on attrition rates among intervention samples? Was severe overall attrition documented? If so, is attrition comparable across samples? Is overall attrition less than 30%?

Yes

No – high level of attrition from session 1 to session 3

N/A

Unknown/Unable to Code

Did the study provide not only internal consistency reliability but also test-retest reliability and interrater reliability (when appropriate) for outcome measures? Were data collectors and/or scorers blind to study conditions and equally (un)familiar to examinees across study conditions?

Yes

No – not blind to study

N/A

Unknown/Unable to Code

Were outcomes for capturing the intervention’s effect measured beyond an immediate post-test?

Yes

No

N/A

Unknown/Unable to Code

Was evidence of the criterion-related validity and construct validity of the measures provided?

Yes

No

N/A

Unknown/Unable to Code

Did the research team assess not only surface features of fidelity implementation (e.g. number of minutes allocated to the intervention or teacher/interventionist following procedures specified), but also examine quality of implementation?

Yes

No

N/A

Unknown/Unable to Code

Was any documentation of the nature of instruction or series provided in comparison conditions?

Yes

No

N/A

Unknown/Unable to Code

Did the research report include actual audio or videotape excerpts that capture the nature of the intervention?

Yes

No

N/A

Unknown/Unable to Code

Were results presented in a clear, coherent fashion?

Yes

No

N/A

Unknown/Unable to Code

Desirable Quality Indicators Total Score: 4

	Total	Score
Essential Quality Indicators Total of ≥ 9 = Score 1 Total of < 9 = Score 0	9	1
Desirable Quality Indicators Total of ≥ 4 = Score 2 Total of < 4 = Score 1 Total 0 = Score 0	4	2
Total Score (3 = High Quality; 2 = Acceptable Quality; < 2 = Poor Quality)		2

Study Rating: Acceptable Quality