Relationship Between Growth Mindset and Intelligence

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Abstract: Individuals with a growth mindset believe that basic abilities such as intelligence and talent can be increased. Those with a fixed mindset are less likely to believe this will happen. Building growth mindset in students has become a priority for many educators in grades K-12 since it suggests that intelligence is a malleable characteristic that can get stronger with practice and lead to greater achievement in school. The current study investigated the relationship between talent mindsets and intelligence. We measured the mindset of undergraduate students and compared these scores to their performance on verbal and non-verbal intelligence tests. No correlation between mindset and verbal and non-verbal intelligence test scores was found. These results extend existing findings to include a lack of relationship between growth mindset and verbal intelligence.

Keywords: Implicit Beliefs, Growth Mindset, Fixed Mindset, Intelligence

Introduction

All humans have basic assumptions of themselves and their world, and these implicit beliefs influence many aspects of one's life. One of the implicit beliefs people have is about their own intelligence, or their ability to acquire and apply knowledge and skills. One theory suggests that people typically take one of two views on their own intellect: either it is a fixed and immutable entity, or it can be changed or improved upon with effort, an incremental or growth mindset (Dweck, 2000, 2006). Fostering a growth mindset has become a priority across the education system in North America (Boaler, 2013) since it suggests that people can improve skills and abilities with practice.

When placing growth mindset within a classroom context, students interpret the environment through the beliefs of their abilities. Some students may focus negatively on subjects they struggle with, such as mathematics. With a fixed mindset, these students believe that they cannot improve in a certain subject, and as a result, fail to persevere. In response to this classroom phenomenon, the mathematics curriculum in Ontario has recently been revised to introduce goals that are tied to social-emotional learning (SEL; Ministry of Education, 2020). These learning goals include the ability to maintain positive motivation and perseverance, and the ability to recognize sources of stress and cope with challenges—both important aspects of building a growth mindset. Intuitively then, growth mindset seems to connect with intelligence, but there are still many unanswered questions. Is it the case that those with a growth mindset would be more likely to persevere through challenging tasks and learn from their mistakes, thereby increasing their intelligence? Perhaps if one has a growth mindset, they begin to learn that their intelligence is not fixed and over time they continue to grow with each new and challenging task. On the other side of the coin, if a person has a fixed mindset and is more likely to give up when they are unsuccessful, does this negatively affect their ability to grow their intelligence? There may also be an opposite relationship, in which one's level of intelligence leads to either a growth or fixed mindset. In other words, is it possible that those who have higher intelligence have more belief in their ability to improve intelligence and talent? Perhaps by observing their heightened ability to use intellect, those with higher intelligence come to believe that they worked hard and thus are responsible for their intellectual ability, whereas those with lower ability to use intellect might give up after repeated failures at implementing intellectual skills and develop a belief that they cannot improve. Alternatively, there might be no relationship between intelligence and intelligence mindset.

The literature suggests that individuals who have greater intelligence have increased cognitive flexibility, both for problem-solving and other non-verbal skills (Campbell et al., 2017; Colzato et al., 2006; Kafadar & Orhan, 2016) and for choosing appropriate vocabulary and other verbal skills (Dommes et al., 2011; Greengross & Miller, 2011; Matthew & Stemler, 2013). Perhaps intellectual agility and flexibility are associated with having a growth mindset. We were unable to locate any research on this question, although researchers have studied a related topic (Tseng et al., 2020). It is possible that having increased ability to flexibly reason and a larger vocabulary that affords more appropriate word selection—two core aspects of intelligence—are associated with a belief that intelligence and talent are malleable. Individuals with greater reasoning skills may be more aware that they can grow their vocabulary and develop new ways to solve problems, just as they are aware that multiple words can be used to identify an object or multiple matching choices must be considered to decide which complex figure fits with other complex figures. In essence, higher intelligence individuals have successfully taught themselves more words and more logic strategies, and thus they successfully modified their ability to perform well on an intelligence test (i.e., their intelligence successfully "grew" by virtue of their efforts). Lower intelligence individuals have experienced less growth of vocabulary and logic skill (i.e., their intelligence was relatively "fixed").

Although these scenarios are possible, there is one core feature of learning that should be considered: nearly everyone has shown an ability to learn and understand in some sort of context, including the ability to apply knowledge to manipulate one's environment, and thus nearly everyone has shown "intelligence" as it is commonly defined (*Intelligence*, n.d.). It could be that the ease with which each person learned in the past influences whether they believe in the malleability of intelligence, and this likely is unrelated to level of intelligence as measured by a formal psychological test. Formal tests are limited and artificial, whereas there are infinite other domains that are important measures of learning.

Growth and Fixed Mindset

Mindset is a belief about oneself and one's basic qualities (Dweck, 2006). There are two types of mindsets: growth and fixed. Growth mindset is commonly referred to as an incremental view. Individuals who believe their intelligence is malleable tend to develop learning goals. Individuals with a growth mindset tend to seek an understanding of material and expansion of knowledge (Henderson & Dweck, 1990). Learning goals influence students to choose and persist on more challenging tasks that foster learning. On the other hand, fixed mindset is commonly referred to as an entity view. Those who believe intelligence is stable tend to develop performance goals (Dweck, 1999). Individuals with a fixed mindset tend to be concerned about outward impressions and apprehensive about their grades (Cain & Dweck, 1995).

Each mindset approach produces costs and benefits (Dweck et al., 1995b). A fixed mindset assists with development of a parsimonious and knowable reality. It also can lead to feelings of hopelessness. A growth mindset fosters persistence in the face of obstacles. It also leads to a more complex reality, which might not be knowable. The lack of stability could lead to feelings of frustration and disconcertedness. Overall, there appear to be fewer costs associated with growth mindset and fewer benefits associated with a fixed mindset.

Growth Mindset and Academic Achievement

Yeager, Paunesku, et al. (2013) produced a white paper examining implementation of growth mindset in educational settings. They reached the conclusion that teaching a growth mindset would improve academic performance and reduce dropouts from school. However, it is useful to examine these claims, since it is not a given that growth mindset interventions will be effective. For example, a large-scale study including 500 introductory computer science students within seven different universities compared a growth mindset intervention to an attention-matched control (Burnette et al., 2020). The growth mindset intervention consisted of four parts, teaching students about growth mindset using research-based evidence, delivering growth mindset messages, a role model delivering tips for success, and lastly a writing exercise used to encourage adoption of growth mindset messages. Burnette et al. (2020) concluded no overall benefits were found from the growth mindset intervention on computer science grades, ultimately questioning the proposition of growth mindset improving academic performance.

Much of the mindset literature uses large samples (Paunesku et al., 2013). Thus, it is critical that researchers consider the effect size of growth mindset effects, since even very small effect sizes will reach statistical significance. Very small effect sizes might not warrant translation of growth mindset to the classroom. Benefits of a growth mindset intervention on math grades were 2% (Blackwell et al., 2007), within a relatively high achieving and moderate-income sample. 2% is not a particularly meaningful improvement, given that some studies – including studies with a large sample size – have failed to find growth mindset intervention benefits?

Some interventions focus analyses on low-performing or at-risk participants. A study with undergraduates found a 3% improvement in grade point average for black students, but only a 2%

improvement for white students (Aronson et al., 2002). In addition, a high school study showed a 5% improvement in courses passed, within a low-performance sample (Yeager, Paunesku, et al., 2013). Furthermore, a study with a community college sample taking developmental math showed a 2% increase in course grades after a mindset intervention relative to a passive control group (Yeager, Paunesku, et al., 2013).

Intelligence

Broadly described, intelligence is an individual's higher cognitive abilities that contribute to tasks such as problem solving, reasoning, and creativity (Sternberg & Lubart, 1999). Cattell (1963) proposed that intelligence is not a uniform entity, but instead can be categorized into two types: fluid and crystallized intelligence. Fluid intelligence comprises the set of abilities involved in abstract problem-solving capability (Cunningham et al., 1975). Some examples of fluid intelligence measures are inductive reasoning, numbers reversed memory, and visual conceptualization (Beauducel et al., 2001). Fluid intelligence is measured with tests that utilize unique problem-solving tasks, such as Ravens Standard Progressive Matrices (Raven et al., 1986). Fluid intelligence tests measure an individual's current reasoning ability, and thus are less affected by differences in learning experiences (Beauducel et al., 2001). On the other hand, crystallized intelligence is evaluated by tests of vocabulary and general information and is associated with accumulated knowledge (Cunningham et al., 1975). It is the result of learning and knowledge acquired over one's lifetime and is greatly impacted by educational factors (Beauducel et al., 2001).

Jensen (1980) claimed that very little could be done to increase one's intelligence level. Nonetheless, there have been multiple attempts to do so, which have resulted in ambiguous results. This research is of key importance as it claims that fluid intelligence is in fact trainable to a certain extent, and therefore it resolves some of the debate over this topic (Jaeggi **et al**., 2008; Sternberg, 2008).

Intelligence generally predicts later achievement. The correlation between intelligence and achievement scores ranges from .21 to .81 (Deary et al., 2007; Diseth, 2010; Jensen, 1980; McCoach et al., 2017), with most correlations above .5. Some evidence has concluded that the effects of cognitive ability on academic achievement are more substantial in early childhood and decrease in early adolescence (Stipek & Valentino, 2015).

Growth Mindset and Intelligence

While academic achievement, course dropouts, course failures, and other academic measures have been examined (Yeager, Paunesku, et al., 2013), there is a paucity of research examining the effect of growth mindset on intelligence. This is surprising, since growth mindset research grew out of growth mindset as a measure of whether intelligence was malleable (Dweck & Leggett, 1988).

Some intervention studies have been run. Li and Bates (2017) conducted three replications of a prior study (Mueller & Dweck, 1988). With 624 children aged 10-12, they investigated whether praise intended to instill a growth mindset would improve intelligence test performance relative to fixed mindset or non-mindset inducing praise. Unlike the original study, all three new studies failed to show an effect of growth mindset praise on non-verbal intelligence test performance.

Not all existing studies have been experimental interventions. Studies also exist on the relationship between growth mindset questionnaire scores and other variables. A prospective study showed that having a growth mindset in seventh grade predicted a 2% increase in course grades measured one year later (Blackwell et al., 2007). The same study failed to find a correlation between growth mindset and academic achievement scores, when measured at a single time point. A study by Macnamara and Rupani (2017) and a replication conducted by Li and Bates (2017) both found little to no correlation between fluid intelligence and mindset, as did Storek and Furnham (2013). We attempted to replicate this finding and extend it by including both verbal and non-verbal intelligence measures, in aims of providing a more extensive examination of whether a relationship exists between mindset and different types of intelligence measures.

Method

Participants

For this study, 90 undergraduate students (74% female, 25% male) were recruited from an Undergraduate Research Participant Pool. Students received a small amount of academic credit in exchange for research participation. Participants were proficient in English and between 18 and 43 years of age (M = 20.0, SD = 3.5). Participants identified as South Asian (23%), white (19%), black (16%), Middle Eastern (12%), Hispanic (11%), East Asian (8%), or other (10%). Mothers had completed less than high school (10%), high school (16%), college or university (67%), or a graduate degree (5%). All participants provided written informed consent, and the study was approved by the university's ethics review board. We recruited enough participants to ensure at least moderate support for either the experimental or null hypothesis, for all analyses of interest, using Bayesian t-tests (i.e., $0.33 > BF_{10} > 3$).

Design

This study consists of a correlational research design as it involves the measurement of mindset and intelligence, and an assessment of the relationship between these variables. There are various strengths associated with the use of correlational research designs such as, firstly correlations are an efficient way to determine whether the existence of a relationship is present between two variables (Stangor, 2011). Secondly, it describes the strength of the relationship as it provides a correlation coefficient that depicts the strength (Stangor, 2011). Although there are various strengths associated with the use of a correlational research design, there are also some limitations. Firstly, correlations do not equal causation, it is impossible to claim that one variable causes the other variable, leading it difficult to establish cause and effect (Stangor, 2011). Secondly, correlational studies cannot provide conclusive information about causal relationships among variables, as this can only be done through experimental research designs that manipulate the independent variable (Stangor, 2011).

Procedure

Participants were tested in a lab room. Upon completion of the consent form, participants completed the Dweck Mindset Instrument, a shortened version of Raven's Standard Progressive Matrices, which consisted of 9 items, and the Kaufman Brief Intelligence Test, second edition. The study took approximately 35-40 minutes to complete.

Measures. Participants were asked to complete a brief demographics questionnaire that included questions about sex, age, ethnicity, mother's education level, and proficiency in English.

Dweck Mindset Instrument (Intelligence and Talent Questionnaires). A questionnaire, the Dweck Mindset Instrument, asked participants to respond to statements about intelligence and talent (Dweck, 2000). Participants responded to eight statements about intelligence mindset (e.g., "You can always substantially change how intelligent you are.") and talent mindset (e.g., "You can change even your basic level of talent considerably."). They selected one of the six options that coincided with their agreement with each statement, Strongly Agree to Strongly Disagree. Responses were coded as 1, 2, 3, 4, 5, or 6 and reverse scored when appropriate such that higher scores reflected more of a growth mindset. Research indicates strong internal consistency for this measure (α =. 82 to .97) and test-retest reliabilities over a two-week interval further demonstrated the reliability of the measure (α =. 80 to .82; Dweck et al., 1995a).

Raven's Standard Progressive Matrices. The Raven's Standard Progressive Matrices (RSPM) test measures participant's fluid intelligence (Raven et al., 1986), by asking them to recognize patterns and problem solve. For the sake of shortening administration time, a condensed 9-item form was utilized (Bilker et al., 2012, Form A). This test derives a score that is equivalent to that from the full scale. Prior to the test, participants were given one practice problem along with feedback on their answers. Reliability for the 9-item subset of the RSPM is .80, compared with .97 for the full RSPM. Support for the content validity of the reduced-item tests is found with an average correlation of **r** = .71.

Kaufman Brief Intelligence Test, Second Edition. The Kaufman Brief Intelligence Test, second edition (KBIT-2), is a test used to measure verbal (crystallized) and nonverbal (fluid) abilities (Kaufman & Kaufman, 2004). There are three subtests: verbal knowledge, matrices, and riddles. The verbal knowledge test consists of 60 items measuring vocabulary and a range of general information. The second subtest is a matrices test, which consists of a 46-item non-verbal measure that is composed of several types of items involving visual stimuli, both objects and abstract symbols. The last subtest is riddles, which consists of 48 items that measures verbal comprehension, reasoning, and vocabulary knowledge. Reliability is .91 for the verbal subtest and is .88 for the non-verbal test.

Hypotheses

We predict that in the current sample, there will be no relationship between intelligence and mindset.

1) Participant's intelligence mindset will not be related to their verbal intelligence score (KBIT-2).
2) Participant's talent mindset will not be related to their verbal intelligence score (KBIT-2).
3) Participant's intelligence mindset will not be related to their non-verbal intelligence score (KBIT-2, RSPM).
4) Participant's talent mindset will not be related to their non-verbal intelligence score (KBIT-2, RSPM).

Results

Descriptive Statistics

Table 2

Descriptive Statistics for Each Measure

Measure	*M* (*SD*)
Intelligence Mindset	4.1 (0.7)
Talent Mindset	4.1 (1.0)
Raven's Standard Progressive Matrices	3.9 (1.8)
Kaufman Brief Intelligence Test-2, Verbal	91.1 (9.4)
Kaufman Brief Intelligence Test-2, Non-Verbal	91.7 (15.6)

Note. Higher mindset scores correspond to more of a growth mindset. Intelligence and talent mindset scores are out of six. KBIT-2 scores are standardized. RSPM score is out of nine.

Primary Analyses

First, Pearson correlations were used in order to measure the strength and direction of the association between mindset and intelligence scores. Then, multiple regression analyses were completed to see whether ones' intelligence level predicted their mindset, which are included in Table 3. Next, since we predicted no correlation between both mindset and intelligence, Bayesian analyses were needed in order to test the null hypotheses, which are included in Table 4.

Hypothesis 1: Participant's intelligence mindset will not be related to their verbal intelligence score (KBIT-2). A Pearson correlation was run to determine the relationship between intelligence mindset and verbal intelligence scores (KBIT-2). There was no correlation between intelligence mindset and verbal intelligence (r = .061, n = 90, p = .565). Secondly, multiple regression analyses were run to predict intelligence mindsets from verbal intelligence scores. The analysis shows that verbal intelligence scores did not significantly predict intelligence mindsets (β = -.088, t = -.461, p = .646). Following, according to Bayesian analyses, $r = 0.061, BF^{10}$= 0.155, indicating moderate evidence for the null hypothesis.

Hypothesis 2: Participant's talent mindset will not be related to their verbal intelligence score (KBIT-2). A Pearson correlation was run to determine the relationship between talent mindset and verbal intelligence scores (KBIT-2). There was no correlation between talent mindset and verbal intelligence (r = -.135, n = 90, p = .206). Secondly, multiple regression analyses were run to predict talent mindsets from verbal intelligence scores (KBIT-2). The analysis shows that verbal intelligence scores did not significantly predict talent mindsets (β = -.065, t = -.342, p = .734). Following, according to Bayesian analyses, $r = -0.135, BF^{10}$= 0.289, indicating moderate evidence for the null hypothesis.

Hypothesis 3: Participant's intelligence mindset will not be related to their non-verbal intelligence score (KBIT-2, RSPM). A Pearson correlation was run to determine the relationship between intelligence mindset and non-verbal intelligence scores (KBIT-2). There was no correlation between intelligence mindset and non-verbal intelligence (r = -.019, n = 90, p = .856). In addition, for the second non-verbal intelligence measure, RSPM, there was no correlation between intelligence mindset and non-verbal intelligence (r = -.141, n = 90, p = .186). Secondly, multiple regression analyses were run to predict intelligence mindsets from non-verbal intelligence scores (KBIT-2). The analysis shows that non-verbal intelligence (KBIT-2) scores did not significantly predict intelligence mindsets (β = -.173, t = -.630, p = .530). For the second non-verbal intelligence score (RSPM) analysis shows that scores did not significantly predict talent mindsets (β = -.167, t = -.712, p = .479). Following, according to Bayesian analyses, $r = -0.019, BF^{10}$= 0.134, indicating moderate evidence for the null hypothesis. For the second non-verbal intelligence score (RSPM), $r = -0.141, BF^{10}$= 0.311, indicating moderate evidence for the null hypothesis.

Hypothesis 4: Participant's talent mindset will not be related to their non-verbal intelligence score (KBIT-2, RSPM). A Pearson correlation was run to determine the relationship between talent mindset and non-verbal intelligence scores (KBIT-2). There was no correlation between talent mindset and non-verbal intelligence (r = .017, n = 90, p = .875). In addition, for the second non-verbal intelligence measure (RSPM) there was no correlation between talent mindset and non-verbal intelligence (r = -.167, n = 90, p = .115). Secondly, multiple regression analyses were run to predict a talent mindset from ones' non-verbal intelligence score (KBIT-2). The analysis shows that non-verbal intelligence scores (KBIT-2) did not significantly predict talent mindsets (β = .193, t = .707, p = .482). For the second non-verbal intelligence score (RSPM) analysis shows that scores did not significantly predict talent mindsets (β = -.376, t = -1.607, p = .112). Following, according to Bayesian analyses, $r = 0.017, BF^{10}$= 0.133, indicating moderate evidence for the null hypothesis. For the second non-verbal intelligence score (RSPM), $r = -0.167, BF^{10}$= 0.446, indicating anecdotal evidence for the null hypothesis.

Table 3

Regression Analyses

	Unstandardized B	SE	Beta	*t*-value	*p*-value
Intelligence Mindset					
Age	-.033	.025	-.151	-1.296	.198
RSPM	-.547	.768	-.167	-.712	.479
KBIT-2 Verbal	-.007	.015	-.088	-.461	.646
KBIT-2 Non-Verbal	-.008	.013	-.173	-.630	.530
Talent Mindset					
Age	.015	.033	.051	.440	.028
RSPM	-1.623	1.010	-.376	-1.607	.112
KBIT-2 Verbal	-.007	.020	-.065	-.342	.734
KBIT-2 Non-Verbal	.012	.017	.193	.707	.482

Table 4

Bayesian Pearson Correlation

				95% Credible interval	
		r	BF^{10}	Lower	Upper
Intelligence_Score	- Talent_Score	0.476	8368.890	0.293	0.616
IQ_Verbal	- IQ_NonVerbal	0.170	0.467	-0.038	0.359
IQ_NonVerbal	- RSPM_percentile	0.495	24243.408	0.315	0.631
Intelligence_Score	- IQ_Verbal	0.061	0.155	-0.145	0.261
Intelligence_Score	- IQ_NonVerbal	-0.019	0.134	-0.222	0.186
Intelligence_Score	- RSPM_percentile	-0.141	0.311	-0.333	0.068
Talent_Score	- IQ_Verbal	-0.135	0.289	-0.327	0.074
Talent_Score	- IQ_NonVerbal	0.017	0.133	-0.188	0.220
Talent_Score	- RSPM_percentile	-0.167	0.446	-0.356	0.041

Note. Intelligence score refers to Dweck's Intelligence Mindset Score. Talent score refers to Dweck's Talent Mindset Score. IQ Verbal refers to the KBIT-2 verbal score. IQ Non-Verbal refers to the KBIT-2 non-verbal score.

Discussion

It is surprising that almost no evidence exists on whether mindset and intelligence are linked, given the growth mindset idea grew from a hypothesis that belief in the malleability of intelligence is important (Trei, 2007). We replicated prior research, which found no relationship between growth mindset and intelligence (Macnamara & Rupani, 2017; Li & Bates, 2017). We extended previous findings by showing that neither verbal nor non-verbal intelligence are linked to growth mindset—belief that intelligence is malleable.

Growth mindset has been a popular topic in the media, with claims about the benefits it provides (Busch, 2018; Dweck, 2016; Robson, 2020). Similarly, the education system has embraced the concept of growth mindset, with educators implementing growth mindset in their daily lessons and activities (Editorial Projects in Education, 2016; Ontario Ministry of Education, 2016; Steinhauer & Helling, 2015). Is this enthusiasm warranted? Existing literature has demonstrated a relationship between possessing a growth mindset and performing well academically (Dweck, 2000). However, a meta-analysis found that the relationship between mindset and academic achievement was weak (r = .10), with only 37% of the studies showing a significant positive association (Sisk et al., 2018).

Educators often focus not on the malleability of intelligence, but rather a broader ability to learn and grow (Ontario Ministry of Education, 2016). Indeed, growth mindset has evolved from its early focus on malleability of intelligence to encompass malleability of other domains, such as personality and social skills (Schleider & Weisz, 2017; Yeager & Dweck, 2012; Yeager, Trzesniewski, & Dweck, 2013). This change of focus mirrors its implementation in the education system.

It is not the case that mindset must be related to intelligence to be useful in the classroom. It is essential to keep in mind that formal intelligence tests are limited and artificial and may not be accurate depictions of an individual's ability to learn. Belief in one's ability to improve could reflect a greater amount of self-confidence. Developing a belief that one can do better could alter level of motivation. Studies have demonstrated the positive effects growth mindset has on students' motivation levels (Blackwell, Trzesniewski, Dweck, 2007; Dweck & Master, 2009). It is the idea that a growth mindset will allow an individual to recognize the inherent value of tasks and consequently generate intrinsic motivation towards school or work.

Limitations

This study contains a few limitations. The first limitation study is in regard to the lack of literature. When the study was taken on, there was minimal research done in this field and therefore seen as one of the limitations for the present study.

The second limitation was the sample used in this study, which consisted of 90 undergraduate students. Often, it is believed that individuals applying for university may already be a sample with above-average abilities. It was found that the average IQ for the students was 91, which is generally a low average IQ considering students are enrolled in a university. Thus, it is possible that this may have affected the types of mindsets participants endorsed, leading to a lack of a correlation between intelligence and mindset (Li & Bates, 2017).

Conclusion

There is a paucity of evidence on whether there is a relationship between mindset and intelligence test performance. We replicated previous studies that showed no relationship between degree of growth mindset and intelligence, and we showed that both fluid and crystalized intelligence fail to show a relationship with mindset.

Ultimately, findings have implications for the education system in regard to re-evaluating the emphasis that has been placed on growth mindsets. Through re-evaluating the emphasis placed on growth mindset within the education system, there can also be a better prioritization of the role of interventions in an effort to benefit students' performance. Additionally, if intelligence increase is a concern, teachers should be taught how to use intelligence measures to effectively design instruction in a way that leads to increased achievement.

Lastly, further research is required on intelligence and mindset in order to gain enhanced reliability and generalizability. Further studies could potentially use students from various institutions to allow for varying mindsets and intelligence levels.

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