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Growth mindset is not associated with scholastic aptitude in a large sample of university applicants

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ABSTRACT

Implicit theories of intelligence have been proposed to predict a large number of different outcomes in education. The belief that intelligence is malleable (growth mindset) is supposed to lead to better academic achievement and students' mindset is therefore a potential target for interventions. The present study used a large sample of university applicants ($N = 5653$) taking a scholastic aptitude test to further examine the relationship between mindset and achievement in the academic domain. We found that results in the test were slightly negatively associated with growth mindset ($r = -0.03$). Mindset showed no relationship with the number of test administrations participants signed up for and it did not predict change in the test results. The results show that the strength of the association between academic achievement and mindset might be weaker than previously thought.

Intelligence predicts a large number of important life outcomes (Neisser et al., 1996). Apart from the level of intelligence itself, people may also differ in their implicit theories about the nature of intelligence and its malleability. On one end of the continuum, some people consider intelligence fixed and unchangeable. On the opposite side, some people believe that intelligence can be improved and developed. These two views are labeled as a fixed mindset and growth mindset, respectively (Dweck, 2012; Dweck & Leggett, 1988; Molden & Dweck, 2006). A recent meta-analysis showed that implicit theories about intelligence are associated with various aspects of self-regulation (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013). People with growth mindset tend to set learning goals rather than performance goals, they tend to adopt strategies focused on mastery rather than helpless-oriented strategies, and when monitoring their goal achievement, they tend to focus on future expectations of success rather than negative emotions. Importantly, the self-regulatory processes associated with growth mindset are positively associated with goal achievement. Growth mindset itself was therefore shown to be associated with a higher likelihood of achieving one's goals; however, the results of the meta-analysis suggest that the association is weak (Burnette et al., 2013).

While Burnette et al. (2013) showed the association between implicit theories and achievement, some research (e.g., Blackwell, Trzesniewski, & Dweck, 2007; see also Yeager et al., 2014) suggests that people with growth and fixed mindset may not differ in their baseline abilities and the difference appears only when encountering adversities or challenging situations. For example, students with growth and fixed mindset may not differ in their mathematics grades before entering junior high school, but the transition to high school poses a significant challenge to which students with growth mindset might adapt better. As a results, mathematics grades were shown to start to diverge between students with growth and fixed mindset over the first two years of junior high school even though they were at a similar level at the beginning of high school (Blackwell et al., 2007).

Given the association of growth mindset with goal achievement, changing students' mindsets has been proposed as a possible intervention for improving academic achievement (Rattan, Savani, Chugh, & Dweck, 2015). Supporting this possibility, some studies demonstrated that interventions teaching the malleability view of intelligence positively affected academic achievement among high school (e.g., Paunesku et al., 2015; Yeager, Romero et al., 2016) as well as university students (Yeager, Walton et al., 2016).

The present study explores the association between implicit theories of intelligence and results of a scholastic aptitude test in a large sample of 5653 university applicants. A number of previous studies show that results in similar tests of scholastic aptitude can be improved by general

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or special preparation (e.g., Becker, 1990; Montgomery & Lilly, 2012; Powers, 1985; Powers & Rock, 1999), which suggests that self-regulatory processes associated with growth mindset might positively influence the performance on the test, assuming that people with growth mindset are more likely to actively prepare for the test. While some studies have already explored the association between implicit theories of intelligence and academic achievement, the present study enables a more precise estimation of the strength of the association due to the large sample size. Apart from studying the association between mindset and results in a scholastic aptitude test, we explored whether people with growth mindset are more likely to take an opportunity to participate in a higher number of administrations of the test, hypothesizing that they may be more likely to believe that they could improve between the administrations. Finally, we also explored whether growth mindset predicts improvement between two administrations of the test.

1. Method

1.1. Participants

The materials were administered as a part of a voluntary questionnaire given before administration of the *General academic prerequisites* (GAP) test used for university admissions in the Czech Republic. The questionnaire with the study materials was administered on a paper right before the GAP test. The questionnaire was given to 6879 people out of whom 5989 filled it (87.1%). The participants who filled the questionnaire were less likely to be men, $t(6818) = -7.73$, $p < 0.001$, $d = -0.28$, 95% CI = [−0.35, −0.21], $M_{\text{filled}} = 0.40$, $M_{\text{did not fill}} = 0.54$, were somewhat younger, $t(6877) = -2.69$, $p = 0.007$, $d = -0.10$, 95% CI = [−0.17, −0.03], $M_{\text{filled}} = 20.01$, $M_{\text{did not fill}} = 20.29$, but their GAP test results did not differ from the participants who did not fill the questionnaire, $t(6877) = 0.75$, $p = 0.45$, $d = 0.03$, 95% CI = [−0.04, 0.10], $M_{\text{filled}} = 0.00$, $M_{\text{did not fill}} = -0.02$.

Three hundred and thirty-six participants (5.6%) failed to properly fill at least one of the measures used in the present study and they were therefore excluded from analysis. The excluded participants had somewhat worse GAP test results than participants who remained in the data set, $t(5987) = -2.68$, $p = 0.007$, $d = -0.15$, 95% CI = [−0.26, −0.04], $M_{\text{excluded}} = -0.14$, $M_{\text{remaining}} = 0.01$.[1] The analysis was performed with data from the remaining 5653 participants, out of whom 59.6% were women, 39.7% were men, and the remaining 0.6% did not indicate their gender. Most of the participants were 18–20 years old (88.2%; $Mdn_{\text{age}} = 19.3$, $IQR_{\text{age}} = 0.9$).

Apart from the first questionnaire, we had data available from later administrations of the GAP test, which took place three, seven, and eleven weeks after the first data collection. All administrations took place during the high school academic year. The later administrations were attended by 6798; 5427; and 2616 people respectively. Out of the 5653 participants from the first data collection, 2805; 1782; and 916 participated in later data collections. A mindset measure was only part of the first data collection.

1.2. Measures

1.2.1. Mindset

Participants' mindset was measured using a Czech translation of a scale with two items: “I can learn new things, but I can't really change my basic intelligence” and “I have a certain amount of intelligence and I really can't do much to change it” (Paunesku et al., 2015). The items were introduced by the question: “To what degree do you agree with these statements?” and were rated on a 7-point scale ranging from 1 (strongly agree) to 7 (strongly disagree). Higher ratings therefore indicate a growth mindset. Answers to the two items correlated highly, $r(5651) = 0.52$, 95% CI = [0.50, 0.54], $p < 0.001$.

1.2.2. Test of general academic prerequisites

The GAP test is used for university admissions at the undergraduate level by a wide range of Czech universities with a variety of study programs. Its structure is similar to the *Graduate record examination* (GRE) used in tertiary education in the United States. It has a pen-and-paper format and it consists of four parts – verbal, quantitative, logic, and argumentation. Each part consists of 22 or 23 items, and is administered separately. Participants have 20 min for completion of the verbal part and 30 min for each of the three remaining parts. All items have multiple-choice format with 5 possible answers out of which only one is correct. There is no penalty for incorrect answers. Our dataset contained information about test results in the form of a participant's percentile rank in each part of the test and overall result computed as the mean of these percentile ranks. We used McCall transformation (McCall, 1939) for normalization of the scores in all parts of the GAP test as well as for the overall score. That is, we computed percentiles from the variables and then assigned z-scores to the percentiles based on the standard normal distribution. The analysis was conducted using the normalized scores.

The GAP test is administered in total 6 times per academic year and every person can sign up for any number of the administrations. Only the best test result is used by universities for admission decisions. The data used in the present study are from the third to sixth administration in the academic year of 2015/16. We also had available data about the number of administrations for which the participants signed up and data about the number of previous tests they had already taken before the third administration.

The available information about the GAP test shows reasonable psychometric properties. A study with 108 participants conducted using a previous version of the test showed a correlation of 0.76 of the overall score in the GAP test with the score in the Scholastic aptitude test (SAT; https://osf.io/32rpu/). The same study found Cronbach's α of 0.91 for the GAP test. Another study with 290 participants showed that the overall score in the GAP test correlates with $r = 0.5$ with the score in Raven's advanced progressive matrices (https://osf.io/xaeu6/). The GAP test results of the third administration correlated highly with the result of fourth, $r(2803) = 0.82$, 95% CI = [0.80, 0.83], $p < 0.001$, fifth, $r(1780) = 0.82$, 95% CI = [0.80, 0.83], $p < 0.001$, and sixth administration, $r(914) = 0.78$, 95% CI = [0.76, 0.81], $p < 0.001$, which shows high test-retest reliability of the test. Further information about the test can be found on https://osf.io/gd7ws/.

2. Results[2]

The average of the two questions used for measuring mindset ($M = 3.97$, $SD = 1.44$) correlated slightly negatively with the result in the GAP test, $r(5651) = -0.03$, 95% CI = [−0.05, −0.00], $p = 0.04$, meaning that participants with more *fixed* mindset had slightly better results. An analysis conducted using only participants who took part in the test for the first time showed similar results, $r(3220) = -0.01$, 95% CI = [−0.05, 0.02], $p = 0.41$. The analysis of the two items separately shows that

[1] Given that the data were not missing completely at random (Schafer & Graham, 2002), we checked the main results of the reported analyses using data multiply imputed with mice R package (van Buuren & Groothuis-Oudshoorn, 2011). The results were virtually the same. We therefore report analyses using listwise deletion for simplicity and the results using imputed data can be found at https://osf.io/dk5ab/. Note that it is possible that the data could have been missing not at random if the rate of missing values for mindset items was influenced by mindset itself. This would result in biased estimates of the association between GAP test results and mindset and it should be taken into account when interpreting the results. We do not have any theoretical reason to believe that the missingness was influenced by mindset and the bias would probably not be strong given the relatively low rate of missing data.

[2] Data and R scripts used for analysis can be found on https://osf.io/vujtd/.