



The effect of growth mindset on reasoning ability in Chinese adolescents and young adults: the moderating role of self-esteem

Daoyang Wang^{1,2} · Lin Gan³ · Cuicui Wang⁴

Accepted: 28 January 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC part of Springer Nature 2021

Abstract

Cognitive ability is critical for an individual's academic, social, and career success. Reasoning ability is one of the most important cognitive abilities, and ways to improve individuals' reasoning ability is therefore of great interest. Growth mindset is the belief that skills are malleable, and individuals with a growth mindset therefore believe that their reasoning ability can be improved through effort. However, the effect of growth mindset on reasoning ability remains unclear, particularly in adolescents and young adults. This study investigated the effect of growth mindset on reasoning ability in 1083 Chinese adolescents and young adults, and examined the moderating role of self-esteem. Growth mindset was positively correlated with reasoning ability ($r = 0.38$, $p < 0.01$), and self-esteem was positively correlated with both growth mindset ($r = 0.43$, $p < 0.01$) and reasoning ability ($r = 0.25$, $p < 0.01$). Regression analysis showed that the interaction between self-esteem and growth mindset significantly predicted reasoning ability ($\beta = 0.149$, $t = 4.39$, $p < 0.001$), which indicates that self-esteem moderated the relationship between growth mindset and reasoning ability. Simple slope analysis further revealed that the correlation between growth mindset and reasoning ability was stronger in the high self-esteem group than in the low self-esteem group ($F_{(3,1105)} = 69.54$, $p < 0.001$, $f^2 = 0.19$). Overall, our results indicate that growth mindset benefits reasoning ability in Chinese adolescents and young adults, and that enhancing self-esteem could strengthen this effect.

Keywords Growth mindset · Reasoning ability · Self-esteem · Cognitive ability · Chinese adolescents and young adults

Introduction

Cognitive abilities are general mental capabilities, including reasoning, attention, and memory (Carroll, 1993). Reasoning ability is one of the most important cognitive abilities (Fisher, 1951); it refers to the process of logical thinking, problem

solving, and the ability to reach logical conclusions (Sorenson, 1954; Stanovich & West, 2000). Reasoning ability has two dimensions: analogical reasoning and inductive reasoning (Dong & Lin, 2011; Rani, 2017). Analogical reasoning refers to the ability to draw logical conclusions from known evidence; it starts with a known generalized statement or principle and applies it to specific cases. By contrast, inductive reasoning is a specialized thinking with the aim of discovering or constructing a generalized principle using specific cases. Many studies have revealed that reasoning ability is essential for students' academic achievement (Bhat, 2016; Devi, 2017; Karbach, Gottschling, Spengler, Hegewald, & Spinath, 2013; Rani, 2017). For example, Rani (2017) reported that reasoning ability was positively correlated with academic achievement in secondary school students in Trivandrum, India. Bhat (2016) also found that reasoning ability predicted academic achievement in high school students, and reasoning ability could explain 31.5% of the variance in academic achievement. Reasoning ability is not only essential for an individual's academic achievement, but is also critical for an individual's social and career success (Duckworth & Seligman, 2005; Perera & DiGiacomo, 2013). Identifying ways to improve

✉ Lin Gan
ganlin@tju.edu.cn

✉ Cuicui Wang
778925247@qq.com

¹ College of Education, Hangzhou Normal University, Hangzhou 310018, China

² Collaborative Innovation Center of Assessment toward Basic Education Quality, Beijing Normal University, Beijing 100875, China

³ School of Precision Instrument and Opto-electronics Engineering, Tianjin University, Tianjin 300072, China

⁴ State Key Laboratory of Cognitive Neuroscience and Learning and IDG/McGovern Institute for Brain Research, Beijing Normal University, Beijing 100875, China

individuals' reasoning ability is therefore of significant interest. To address this question, Dweck and Leggett (1988) proposed the concept of "learning orientation": if reasoning ability is seen as malleable, it should be possible to improve it. Growth mindset is the belief that attributes such as reasoning ability and personality are changeable (Dweck, 2006). Individuals with a growth mindset are more likely to believe that their reasoning ability can be improved over time through effort than those without a growth mindset (Dweck, 2012; Han, Choi, Dawson, & Jeong, 2018).

Growth mindset can help individuals to cope with challenging situations (Yeager et al., 2016). Individuals with a growth mindset are more willing to learn and grow through their failures. They also learn from the success of others and use constructive feedback to improve themselves (Blackwell, Trzesniewski, & Dweck, 2007; Saunders, 2013). Adolescence and young adulthood are critical stages for the development of academic and cognitive abilities (Blakemore, 2008; Nelson, Jarcho, & Guyer, 2016). Studies have revealed that a growth mindset is more beneficial for academic achievement in high school students (adolescence and young adulthood) who face many challenges (Bahník & Vranka, 2017; Blackwell et al., 2007). Growth mindset has been found to facilitate mathematical skills in adolescent junior high school students (Blackwell et al., 2007). However, Bahník and Vranka (2017) found no association between growth mindset and academic aptitude in a large sample of college students. Dweck (2008) showed that a growth mindset significantly predicted mathematics performance over time, and that discrepancies in mathematical ability between individuals can be reduced via growth mindset interventions. For the main part, these studies have revealed that growth mindset is important for adolescents and young adults, who face many challenges during this period of life. However, previous studies have mainly focused on the positive effect of growth mindset on academic achievement (Blackwell et al., 2007; Grant & Dweck, 2003), and there is little evidence for the direct effect of growth mindset on reasoning ability, particularly in adolescents and young adults (Li et al., 2017). Therefore, the present study investigated the effects of growth mindset on reasoning ability in adolescents and young adults.

Individuals with growth mindsets have been reported to have greater self-esteem, which is a characteristic that is thought to facilitate academic and/or cognitive abilities (Anderson, Hildreth, & Howland, 2015; Blackwell et al., 2007; Dweck, 2006, 2008). Self-esteem refers to an individual's sense or value of themselves (one's self-worth) (Anderson et al., 2015; Huitt, 2004). Individuals with stronger self-esteem have been found to have a stronger motivation to learn, as they believe that they have the potential ability to develop their academic and cognitive abilities (Dweck, 2006; Yeager et al., 2016). Furthermore, they tend to orient toward learning goals and are more likely to employ positive

strategies, such as working harder (Blackwell et al., 2007; Dweck, 2008). Several studies have demonstrated a significant relationship between self-esteem and both academic performance and cognitive ability (Arbabisarjou, Zare, Shahrakipour, & Ghoreishinia, 2016; Mugabe, Brug, & Catling, 2016; Shrauger & Osberg, 2010). Self-esteem has also been found to be positively correlated with mathematics, reading, and science performance (Gage & Berliner, 1992), and to promote reasoning ability (Okafor & Yewande, 2015). Therefore, a plausible hypothesis is that self-esteem moderates the effect of growth mindset on cognitive ability (e.g., reasoning) and/or academic achievement in adolescents and young adults.

In summary, the present study examined two research questions. First, does growth mindset enhance reasoning ability in adolescents and young adults? Second, if so, does self-esteem moderate this effect of growth mindset on reasoning ability? We hypothesized that growth mindset enhances reasoning ability in adolescents and young adults, and that self-esteem strengthens the benefits of growth mindset on reasoning ability.

Methods

Participants

This study was conducted between October and November 2018. Participants were 1108 adolescents and young adults aged 14 to 19 years who were students at secondary vocational schools in Anhui Province, China. A total of 25 participants were excluded as a result of poor-quality questionnaire responses, and data from a final total of 1083 participants (55.80% female; mean age: 16.56 years; SD: 2.36 years) were included in the analysis. No participants reported having any learning disabilities or neurological impairments.

The institutional review board at XX Hangzhou Normal University approved this study. Following a comprehensive explanation of the study, written informed consent was obtained from all participants. For participants aged under 18 years, written informed consent was also obtained from their parents/guardians. All participants received a gift to thank them for their participation.

Measures

Demographic Questionnaire Background variables, such as age, gender, and family socioeconomic status (annual family income and parental educational status), were collected using a demographic questionnaire.

The Reasoning Ability Test The Reasoning Ability Test was developed by the National Project Team for the Investigation

of Psychological Development Characteristics of Chinese Children and Adolescents (Dong & Lin, 2011). The analogical reasoning subtest and inductive reasoning subtest of the Reasoning Ability Test were used in the current study. The analogical reasoning subtest includes both digital and figure analogical reasoning tasks (Fig. 1), and the inductive reasoning subtest includes the graphic sequence inference task (Fig. 2). In the present study, the internal consistency α coefficient of each subtest and overall was 0.74–0.94.

The Growth Mindset Inventory Growth mindset was measured using the Growth Mindset Inventory (Dweck, 2006), which includes 20 items. A graduate student who majored in English translated the original English version of Growth Mindset Inventory into Chinese, and accuracy was ensured through a back-translation by a native English speaker. Discrepancies were discussed until an agreement was reached between the author, graduate student who majored in English, and native English speaker. The internal consistency α coefficient of the Growth Mindset Inventory in the present study was 0.80.

The Self-Esteem Scale Self-esteem was measured according to the Self-Esteem Scale (Dong & Lin, 2011). The Chinese version of the Self-Esteem Scale comprises the two following subscales: 1) self-affirmation (five items, e.g., “On the whole, I am satisfied with myself”); and 2) self-denial (four items, e.g., “I often feel that I am useless”). All nine items were scored on a 4-point Likert-type scale, with higher scores indicating more self-esteem. In the present cohort, the Self-Esteem Scale had an internal consistency reliability of 0.92.

Statistical Analyses

All statistical analyses were performed using SPSS 22.0 (Chicago, IL, USA) and MPLUS 7 (Los Angeles, CA, USA). First, a correlation analysis including background variables and growth mindset, self-esteem, and reasoning ability was performed using Pearson’s correlation. Second, a

regression analysis was performed to investigate the independent contribution of growth mindset, self-esteem, and the interaction effect of growth mindset and self-esteem on reasoning ability. Third, a simple slope analysis was performed to examine whether self-esteem moderated the effects of growth mindset on reasoning ability, and f square (f^2) was used as an index of the effect size. The effect size was categorized as small ($f^2 = 0.02$), medium ($f^2 = 0.15$), or large ($f^2 = 0.35$) according to previous work (Aguinis, Beaty, Boik, & Pierce, 2005).

Results

Correlation Analysis

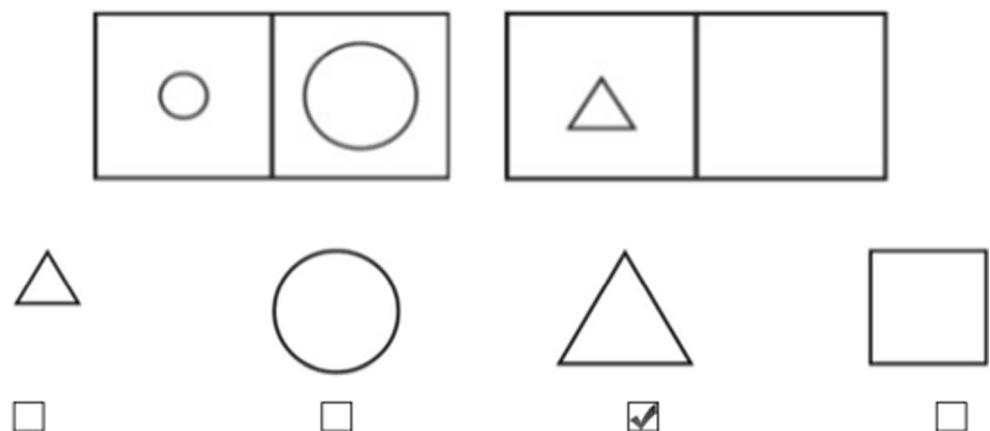
Table 1 shows the descriptive statistics and correlations between background variables (i.e., age, gender, annual family income, and paternal and maternal educational level), growth mindset, reasoning ability, and self-esteem. The growth mindset was significantly correlated with the reasoning ability ($r = 0.38, p < 0.01$). In addition, the self-esteem was positively correlated with both growth mindset ($r = 0.43, p < 0.01$) and reasoning ability ($r = 0.25, p < 0.01$).

Regression Analysis

For Model 1, the background variables, growth mindset, and self-esteem were entered as independent variables into the regression analysis, and the reasoning ability was entered as the dependent variable. For Model 2, the interaction between growth mindset and self-esteem was entered as the independent variable, and the reasoning ability as the dependent variable (Table 2).

In Model 1, of the background variables, gender ($\beta = 0.079, t = 2.54, p < 0.05$) and annual family income ($\beta = 0.094, t = 2.86, p < 0.01$) had significant effects on the reasoning ability. Specifically, the reasoning ability of girls was

Fig. 1 An example of the analogical reasoning ability subtest



2→3; 9→10; 6→? 4□ 5□ 6□ 7□

Fig. 2 An example of the inductive reasoning ability subtest

significantly higher than that of boys, and a higher annual family income was associated with better reasoning ability. After controlling for background variables, the growth mindset significantly predicted the reasoning ability ($\beta = 0.353$, $t = 10.39$, $p < 0.001$). However, the self-esteem did not significantly predict reasoning ability after controlling for background variables ($\beta = 0.059$, $t = 1.76$, $p > 0.05$).

In Model 2, the interaction between the growth mindset and self-esteem significantly predicted reasoning ability ($\beta = 0.149$, $t = 4.39$, $p < 0.001$), which indicates that self-esteem moderated the relationship between growth mindset and reasoning ability. In addition, the R^2 -change (ΔR^2) between Models 1 and 2 was significant ($\Delta R^2 = 0.018$, $p < 0.001$).

A separate simple slope analysis was performed to elucidate how self-esteem moderated the effect of growth mindset on reasoning ability (Fig. 3). Growth mindset was entered into the simple slope analysis as the independent variable and reasoning ability as the dependent variable. Participants were divided into a high self-esteem group and low self-esteem group according to a cut-off of the mean ± 1 standard deviation of the self-esteem score. The growth mindset was positively correlated with reasoning ability within both the high self-esteem and low self-esteem groups (high self-esteem group: simple slope = 1.09, $t = 11.48$, $p < 0.001$; low self-esteem group: simple slope = 0.71, $t = 5.87$, $p < 0.001$). Further analysis showed that the positive correlation between growth mindset and reasoning ability in the high self-esteem group was stronger than that in the low self-esteem group ($F_{(3,1105)} = 69.54$, $p < 0.001$, $f^2 = 0.19$).

Discussion

This study investigated the relationship between growth mindset and reasoning ability in Chinese adolescents and

young adults, and further assessed the moderation effect of self-esteem in this relationship. We found that growth mindset was positively correlated with reasoning ability, which indicates that growth mindset benefits reasoning ability in Chinese adolescents and young adults. The regression analysis and simple slope analysis further clarified that self-esteem moderated the relationship between growth mindset and reasoning ability. Specifically, higher self-esteem was associated with a more positive effect of growth mindset on reasoning ability. In other words, self-esteem strengthened the positive effects of growth mindset on reasoning ability. Overall, this indicates that growth mindset benefits reasoning ability in Chinese adolescents and young adults, and that self-esteem could enhance this positive effect.

We found that growth mindset was positively correlated with reasoning ability, which fills the gap in the research of the effects of growth mindset on cognitive ability, particularly in adolescents and young adults. Previous studies have indicated that growth mindset may lead to more malleable cognitive abilities and self-attributes such as personality (Dweck, 2012; Ng, 2018). Individuals with a growth mindset believe that reasoning ability is malleable; that is to say, that reasoning ability can be improved with effort (Dweck, Chiu, & Hong, 1995; Yeager & Dweck, 2012). These individuals focus on learning goals that aim to increase their ability, and show greater engagement, persistence, and resilience in the face of setbacks, which may also benefit their reasoning ability (Mangels, Butterfield, Lamb, Good, & Dweck, 2006). Dweck (2008) showed that individuals with a high cognitive ability often develop their abilities through focused and extended efforts, which is precisely the kind of effort fostered by individuals with a growth mindset. Adolescents and young adults with growth mindsets often actively cope with challenging situations, and learn and grow through challenges, which may further promote their cognitive development.

Table 1 Descriptive statistics and correlations between background variables, growth mindset, reasoning ability, and self-esteem

	M	SD	1. Gender	2	3	4	5	6	7
2. Age	16.56	2.36	0.04	–					
3. Annual family income	3.34	2.09	–0.10**	–0.18**	–				
4. Paternal educational level	7.89	3.14	–0.07*	–0.16**	0.27**	–			
5. Maternal educational level	7.19	3.56	–0.12**	–0.23**	0.33**	0.62**	–		
6. Reasoning ability	89.09	11.97	0.11**	0.10**	0.07*	–0.02	–0.05	–	
7. Growth mindset	32.31	4.14	0.10**	0.14**	0.01	–0.05	–0.08**	0.38**	–
8. Self-esteem	24.00	2.91	0.07*	0.03	0.04	0.03	0.01	0.25**	0.43**

* $p < 0.05$; ** $p < 0.01$. M: mean; SD: standard deviation. Gender (male = 0, female = 1)

Table 2 Summary of the regression analysis for variables predicting reasoning ability without the interaction term (Model 1) and with the interaction term (Model 2)

Variable	Model 1		Model 2			
	<i>B</i>	<i>SE B</i>	<i>B</i>	<i>B</i>	<i>SE B</i>	β
Gender (male=0, female= 1)	0.920	0.757	0.079*	0.047	0.749	0.085**
Age	0.769	0.509	0.049	0.736	0.504	0.046
Annual family income	0.534	0.187	0.094**	0.528	0.185	0.093**
Paternal educational level	0.048	0.153	0.012	0.013	0.152	0.003
Maternal educational level	-0.216	0.143	-0.062	-0.227	0.142	-0.065
Growth mindset	0.730	0.103	0.353***	0.963	0.105	0.317***
Self-esteem	0.242	0.138	0.059	0.067	0.142	0.016
Growth mindset×Self-esteem				0.092	0.021	0.149***
R^2		0.172			0.190	
<i>F</i>		25.88***			25.53***	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

The present study found that self-esteem significantly moderated the relationship between growth mindset and reasoning ability. Researchers have demonstrated that while self-esteem cannot directly enhance academic achievement or cognitive ability, it can promote academic or cognitive ability through the belief of effort (Arbabisarjou et al., 2016; Mugabe et al., 2016; Shrauger & Osberg, 2010). The present research showed that higher self-esteem can strengthen the positive effect of growth mindset on reasoning ability. This may be because individuals with a growth mindset usually have stronger self-esteem, they tend to orient toward learning goals and working harder, which may help them develop their reasoning ability (Dweck, 2006).

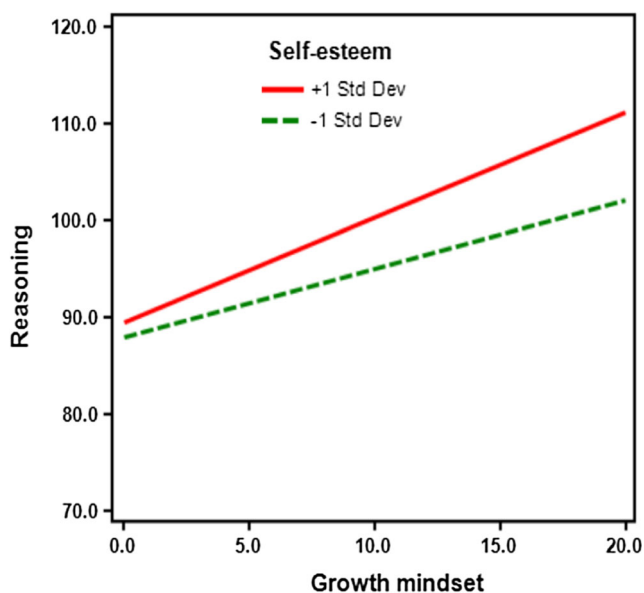


Fig. 3 The results of the simple slope analysis

The participants in the present study were students at secondary vocational schools, whose academic achievements are generally lower than those of academic high school students (Ling, 2015; Yang, 2012). Students with a low academic performance are often characterized by features that adversely impact school adaptation, such as low self-esteem and depression (Cvencek, Fryberg, Covarrubias, & Meltzoff, 2017; Giofrè, Borella, & Mammarella, 2017), and this could have also applied to the secondary vocational school students in the present study. Thus, our findings could facilitate the cognitive development of students with low self-esteem. For example, schools could provide growth mindset interventions for the students, in which teachers could stress that cognitive abilities can be developed through effort, and teach students how to cope with challenges such that they can develop a growth mindset. Alternatively, self-esteem could strengthen the benefits of growth mindset on cognitive ability, and interventions could therefore target students' self-esteem. Previous studies have revealed that social support can facilitate self-esteem, particularly in adolescents and young adults (Hoffman, Ushpiz, & Levy-Shiff, 1988; Smoll, Smith, Barnett, & Everett, 1993; Waters & Moore, 2002). Therefore, parents and teachers could work together to encourage students to attend social activities and seek social support from friends to improve self-esteem.

The present study has some limitations. First, participants were students from secondary vocational schools, and future studies should expand the types of participants such as academic high school students and left-behind adolescents. Second, the present study revealed that growth mindset can benefit reasoning ability in adolescents and young adults. However, we could not conclude that growth mindset is the foundation of reasoning ability, as our analyses did not permit inferences regarding causality. Future studies could use well-

controlled experimental designs to clarify the causal effects of growth mindset on reasoning ability.

Conclusions

The present study found that the growth mindset was positively correlated with reasoning ability, and self-esteem modulated this relationship. Specifically, growth mindset benefits reasoning ability, and that self-esteem could enhance this benefit. The present study provides much promise for how to improve the reasoning ability of adolescents and young adults. Schools and parents can provide growth mindset interventions for adolescents and young adults to improve their reasoning ability.

Author Contributions Daoyang Wang, Lin Gan, and Cuicui Wang designed the study. Daoyang Wang collected, analyzed the data and wrote the manuscript. Lin Gan and Cuicui Wang supervised the whole study.

Funding This study was funded by Philosophy and Social Science Planning Project of Anhui Province (grant number AHSKY2018D28).

Data Availability The data are available from the corresponding author upon reasonable request.

Declarations

Disclosure of Conflict of Interest The authors declare that they have no conflict of interest.

Informed Consent Written consent was obtained from young adults and the parents/guardians of adolescents after a full explanation of the study procedure.

References

- Aguinis, H., Beaty, J. C., Boik, R. J., & Pierce, C. A. (2005). Effect size and power in assessing moderating effects of categorical variables using multiple regression: A 30-year review. *Journal of Applied Psychology, 90*(1), 94–107. <https://doi.org/10.1037/0021-9010.90.1.94>.
- Anderson, C., Hildreth, J. A. D., & Howland, L. (2015). Is the desire for status a fundamental human motive? A review of the empirical literature. *Psychological Bulletin, 141*(3), 574–601. <https://doi.org/10.1037/a0038781>.
- Arbabisarjou, A., Zare, S., Shahrakipour, M., & Ghoreishinia, G. (2016). The relationship between self-esteem and academic achievement motivation in university students. *International Journal of Pharmacy and Technology, 8*(2), 12353–12360.
- Bahník, Š., & Vranka, M. A. (2017). Growth mindset is not associated with scholastic aptitude in a large sample of university applicants. *Personality and Individual Differences, 117*, 139–143. <https://doi.org/10.1016/j.paid.2017.05.046>.
- Bhat, M. A. (2016). The predictive power of reasoning ability on academic achievement. *International Journal of Learning, Teaching and Educational Research, 15*(1), 79–88.
- 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. <https://doi.org/10.1111/j.1467-8624.2007.00995.x>.
- Blakemore, S.-J. (2008). The social brain in adolescence. *Nature Reviews Neuroscience, 9*(4), 267–277.
- Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies*. New York: Cambridge University Press.
- Cvencek, D., Fryberg, S. A., Covarrubias, R., & Meltzoff, A. N. (2017). Self-concepts, self-esteem, and academic achievement of minority and majority north American elementary school children. *Child Development, 89*(4), 1099–1109. <https://doi.org/10.1111/cdev.12802>.
- Dong, Q., & Lin, C. D. (2011). *Standardized tests in children and adolescent mental development in China*. Beijing: Science Press.
- Duckworth, A. L., & Seligman, M. E. P. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science, 16*(12), 939–944. <https://doi.org/10.1111/j.1467-9280.2005.01641.x>.
- Dweck, C. S. (2012). Mindsets and human nature: Promoting change in the Middle East, the schoolyard, the racial divide, and willpower. *American Psychologist, 67*(8), 614–622. <https://doi.org/10.1037/a0029783>.
- Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York: Random House.
- Dweck, C. (2008). *Mindsets and Math/Science Achievement* (Prepared for the Carnegie Corporation of New York–Institute for Advanced Study Commission on Mathematics and Science Education). New York: Carnegie Corporation of New York.
- Dweck, C. S., Chiu, C. Y., & Hong, Y. Y. (1995). Implicit theories and their role in judgments and reactions: A word from two perspectives. *Psychological Inquiry, 6*(4), 267–285. https://doi.org/10.1207/s15327965pli0604_1.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256–273. <https://doi.org/10.1037/0033-295X.95.2.256>.
- Fisher, M. (1951). Senile dementia- a new explanation of its causation. *Canadian Medical Association Journal, 65*(1), 1–7.
- Gage, N., & Berliner, D. (1992). *Educational psychology* (5th ed.). Boston: Houghton Mifflin.
- Giofrè, D., Borella, E., & Mammarella, I. C. (2017). The relationship between intelligence, working memory, academic self-esteem, and academic achievement. *Journal of Cognitive Psychology, 29*(6), 731–747. <https://doi.org/10.1080/20445911.2017.1310110>.
- Grant, H., & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology, 85*(3), 541–553. <https://doi.org/10.1037/0022-3514.85.3.541>.
- Han, H., Choi, Y. J., Dawson, K. J., & Jeong, C. (2018). Moral growth mindset is associated with change in voluntary service engagement. *PLoS One, 13*(8), e0202327. <https://doi.org/10.1371/journal.pone.0202327>.
- Hoffman, M. A., Ushpiz, V., & Levy-Shiff, R. (1988). Social support and self-esteem in adolescence. *Journal of Youth and Adolescence, 17*(4), 307–316. <https://doi.org/10.1007/BF01537672>.
- Huitt, W. (2004). Self-concept and self-esteem. *Educational Psychology Interactive*. Retrieved from <http://chiron.valdosta.edu/whuitt/col/regsys/self.html>.
- Karbach, J., Gottschling, J., Spengler, M., Hegewald, K., & Spinath, F. M. (2013). Parental involvement and general cognitive ability as predictors of domain-specific academic achievement in early adolescence. *Learning & Instruction, 23*(1), 43–51. <https://doi.org/10.1016/j.learninstruc.2012.09.004>.
- Li, P., Zhou, N., Zhang, Y., Xiong, Q., Nie, R., & Fang, X. (2017). Incremental theory of intelligence moderated the relationship between prior achievement and school engagement in Chinese high school students. *Frontiers in Psychology, 8*, 1703–1703. <https://doi.org/10.3389/fpsyg.2017.01703>.

- LiGhinai15). "Bad students go to vocational schools!": Education, social reproduction and migrant youth in urban China. *The China Journal*, 73, 108–131. <https://doi.org/10.1086/679271>.
- Mangels, J. A., Butterfield, B., Lamb, J., Good, C., & Dweck, C. S. (2006). Why do beliefs about intelligence influence learning success? A social cognitive neuroscience model. *Social Cognitive and Affective Neuroscience*, 1(2), 75–86. <https://doi.org/10.1093/scan/nsl013>.
- Mugabe, C., Brug, P., & Catling, J. C. (2016). Cross-cultural difference in academic motivation, academic self-esteem, and upward social mobility within a student cohort. *Psychology Teaching Review*, 22(2), 53–68.
- Nelson, E. E., Jarcho, J. M., & Guyer, A. E. (2016). Social re-orientation and brain development: An expanded and updated view. *Developmental Cognitive Neuroscience*, 17, 118–127. <https://doi.org/10.1016/j.dcn.2015.12.008>.
- Ng, B. (2018). The neuroscience of growth mindset and intrinsic motivation. *Brain Sciences*, 8(2), 20. <https://doi.org/10.3390/brainsci8020020>.
- Okafor, N. P., & Yewande, R. O. (2015). Motivation and self-esteem: Exploring students gender, reasoning levels and interest in secondary school chemistry. *International Journal for Cross-Disciplinary Subjects in Education*, 5(3), 2583–2589.
- Perera, H. N., & DiGiacomo, M. (2013). The relationship of trait emotional intelligence with academic performance: A meta-analytic review. *Learning and Individual Differences*, 28, 20–33. <https://doi.org/10.1016/j.lindif.2013.08.002>.
- Rani, K. V. (2017). Reasoning ability and academic achievement among secondary school students in Trivandrum. *i-manager's Journal on School Educational Technology*, 13(2), 20.
- Saunders, S. A. (2013). *The impact of a growth mindset intervention on the reading achievement of at-risk adolescent students*. Dissertations & Theses, University of Virginia.
- Shrauger, J. S., & Osberg, T. M. (2010). The relationship of time investment and task outcome to causal attributions and self-esteem. *Journal of Personality*, 48(3), 360–378. <https://doi.org/10.1111/j.1467-6494.1980.tb00839.x>.
- Smoll, F. L., Smith, R. E., Barnett, N. P., & Everett, J. J. (1993). Enhancement of children's self-esteem through social support training for youth sport coaches. *Journal of Applied Psychology*, 78(4), 602–610. <https://doi.org/10.1037/0021-9010.78.4.602>.
- Sorenson, H. (1954). *Psychology in Education* (p. 551). New York: Toronto London.
- Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23(5), 645–665. <https://doi.org/10.1017/S0140525X00003435>.
- Waters, L. E., & Moore, K. A. (2002). Predicting self-esteem during unemployment: The effect of gender, financial deprivation, alternate roles, and social support. *Journal of Employment Counseling*, 39(4), 171–189. <https://doi.org/10.1002/j.2161-1920.2002.tb00848.x>.
- Yang, L. (2012). *Enhancing academic self-concept and academic achievement of vocational students : A longitudinal intervention study in mainland China*. Pokfulam: University of Hong Kong.
- Yeager, D. S., & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist*, 47(4), 302–314. <https://doi.org/10.1080/00461520.2012.722805>.
- Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C., et al. (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. <https://doi.org/10.1037/edu0000098>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.