



Research article

The relationship between growth mindset and cognitive fusion in college students is mediated by bias towards negative information

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ARTICLE INFO

Keywords:

Mental health
Mediation analysis
College students in China
Questionnaire
Survey

ABSTRACT

This study aimed to investigate the relationships among growth mindset, cognitive fusion, bias towards negative information, and bias towards positive information. The Growth Mindset Scale, the Attention to Positive and Negative Information Scale, and the Cognitive Fusion Questionnaire were employed. A total of 470 college students in China participated in the study. The findings showed a negative correlation between a growth mindset and cognitive fusion. In addition, a parallel mediation analysis demonstrated that bias towards negative information mediated the relationship between a growth mindset and cognitive fusion and that the indirect effect was significant. However, the mediation of bias towards positive information in this model was not significant. These results suggest that possessing a growth mindset is advantageous for mental health.

1. Introduction

The prevalence of mental illnesses has increased over the past few decades. In 2017, approximately 792 million people (almost 11 % of the global population) reported experiencing poor mental health [1]. As researchers are looking for ways combat mental health problems, extensive research has demonstrated the positive impact of a growth mindset on mental health outcomes [2–4]. A growth mindset is the belief that one's abilities and traits are malleable and can be improved through personal effort. By contrast, individuals with a fixed mindset believe that their abilities and traits are fixed and cannot be altered [5]. Studies have shown that fostering a growth mindset promotes resilience and leads individuals to view difficulties as opportunities for growth and skill development [6,7]. Growth mindset also negatively predicted negative emotions [3,4,8,9]. Individuals with a growth mindset are more "flexible". Growth mindset individuals are able to face life changes more optimistically and adopt appropriate strategies [9,10].

A meta-analysis conducted by Burnette et al. (2020) [8] revealed a negative correlation between growth mindset and psychological distress ($r = -0.220$), as well as positive correlations with treatment value ($r = 0.137$) and positive coping ($r = 0.207$). Individuals with a growth mindset tend to experience lower stress levels and report fewer symptoms of mental illness compared to those with a fixed

Abbreviations: SES, Socioeconomic Status; NSSI, non-suicidal self-injury; GMS, Growth Mindset Scale; APNI, the Attention to Positive and Negative Information Scale; CFQ, the Cognitive Fusion Questionnaire; CFQ-F, Cognitive Fusion Sub-questionnaire.

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<https://doi.org/10.1016/j.heliyon.2024.e34445>

Received 21 December 2022; Received in revised form 12 June 2024; Accepted 9 July 2024

Available online 11 July 2024

2405-8440/© 2024 Published by Elsevier Ltd.

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mindset.

In addition, personal ability and Socioeconomic Status (SES) are closely related to a growth mindset. Numerous studies have shown that individuals with a growth mindset continue to learn and develop their abilities, remain curious and inquisitive, positively seek new knowledge and skills, and strive to improve themselves unlike those with a fixed mindset [7,10,11]. While the association between growth mindset and personal ability is well-established, the relationship between growth mindset and SES remains inconclusive. Some research suggests that individuals in higher SES are more likely to develop a growth mindset [12,13], whereas other studies present conflicting findings [14]. Further research is necessary to clarify this relationship.

Another important factor contributing to mental health is cognitive fusion [15], which refers to the idea that an individual's behavior is influenced by their internal thoughts, particularly negative emotions [16]. According to acceptance and commitment therapy, cognitive fusion leads individuals to automatically extract negative information from their experiences, causing them to become immersed in negative emotions, rather than viewing them as transient states. Bardeen and Daniel (2017) found positive associations between cognitive fusion, anxiety, depression, and post-traumatic stress [17], and cognitive fusion has been found to cause psychological inflexibility and cognitive dissonance [17,18]. The relationship between cognitive fusion and the likelihood of developing mental illness has also been investigated in relation to anxiety, stress, self-esteem, chronic pain, and eating disorders.

Previous studies have consistently demonstrated that cognitive fusion is associated with negative emotions [16,19,20]. High levels of cognitive fusion are related to negative experiences and may be an important factor influencing non-suicidal self-injury (NSSI) [21]. These findings indicate that cognitive fusion not only affects mental health but is also an "unhealthy" state. Cognitive fusion is a manifestation of psychological inflexibility that results in an individual's mental and behavioral inflexibility to adapt to changing circumstances. Given the findings regarding the relation between growth mindset and other traits, we hypothesized that growth mindset would be negatively correlated with cognitive fusion.

Negativity bias entails the inclination to focus more on negative information than on positive information. This reflects an individual's selective activation of processing self-relevant and meaningful information, rather than the positive inhibition of irrelevant stimuli [22]. One might consider such bias as attentional bias for positive or negative information. Positive attentional bias means that individuals are likely to pay attention to the positive aspects of events. In contrast, negative attentional bias refers to those who tend to focus on the negative aspects of events [23]. For comparison, the expression of general 'bias towards negative or positive information' can be used instead of 'attentional bias' as it encompasses a wider range of biases, including attentional bias and memory bias. Bias towards negative information plays a role in the development and maintenance of psychological disorders like anxiety, depression, and post-traumatic stress disorder. Individuals with depression show a persistent increase in bias towards negative information and a decrease in bias towards positive information [24]. Similarly, individuals with anxiety tend to exhibit a bias towards negative information, and struggles in processing positive social information may contribute to prolonged social anxiety [25,26].

A growth mindset and information bias are equally predictive of mental health issues [27,28]. There may be a correlation between growth mindset and information bias. An empirical study suggested that growth mindset not only promoted reflection and self-correction, but also facilitated attentional control and post-error adjustment of behavior [27]. Furthermore, information bias may result from decreased attentional control [28]. In a word, growth mindset was beneficial to attentional control, which was a predictive factor for information bias. Therefore, we hypothesized that a growth mindset would positively predict bias towards positive information and negatively predict bias towards negative information.

Information bias is believed to be related to emotion. For example, a study showed that bias towards negative information was positively associated with anxiety [29]. Some studies also demonstrated that cognitive fusion was related to negative emotions [16,19,20]. Specifically, cognitive fusion was positively associated with anxiety [19]. Thus, information bias is probably related to cognitive fusion. There was no direct evidence that information bias predicted cognitive fusion, a study showed that negative life events positively predicted cognitive fusion. For example, childhood trauma positively predicted cognitive fusion [30]. Negative life events triggered cognitive bias which was bias towards negative information [31]. Consequently, we hypothesized that bias towards negative information would positively predict cognitive fusion, while bias towards positive information would negatively predict cognitive fusion.

To our knowledge, no study has explored the relation among growth mindset, information bias and cognitive fusion in the same set of participants and in a single study. Previous studies have examined the mediating role of information bias. For example, a study has found that information bias mediated the relationship between positive emotions and life satisfaction [32]. Bias towards negative information mediated the relationship between children's perception of interparental conflict and anxiety [33].

1.1. The present study

The present study aims to investigate whether information bias serves as a mediator between a growth mindset and cognitive fusion. We propose three hypotheses regarding the relationship between a growth mindset and cognitive fusion: (1) a growth mindset is negatively correlated with cognitive fusion; (2) bias towards negative information mediates the relationship between growth mindset and cognitive fusion; and (3) bias towards positive information mediates the relationship between a growth mindset and cognitive fusion. By examining these relationships, this study aims to contribute to our understanding of how a growth mindset and cognitive fusion are associated, potentially enhancing the application of growth mindset in the field of mental health. Specifically, growth mindset emphasizes individuals' resilience and coping skills. It helps individuals develop the ability to face uncertainty and stress and improve self-resilience and adaptation. This helps reduce the risk of anxiety and depression and promotes long-term mental health.

2. Materials and methods

2.1. Participants

A power analysis utilizing Monte Carlo Power Analysis for Indirect Effects application (https://schoemanna.shinyapps.io/mc_power_med/) was conducted to determine the required sample size. Based on the correlations of each variable as 0.4 and power as 0.80, at least 157 participants were needed [34,35]. A total of 490 participants were recruited from a university using convenience sampling. Due to missing data, data from 20 participants were excluded, leaving a final count of 470 participants comprising 68 men (14.47 %) and 402 women (85.53 %). The rate of missing data was 4.08 %. The average age of the participants was 18.77 years. Data were collected using questionnaires administered in a computer room. The questionnaire was divided into two sections. The first section targeted at demographic information, including the participants' gender, age, major, personal ability, and SES. The second section incorporated three scales: the Growth Mindset Scale (GMS), the Attention to Positive and Negative Information Scale (APNI), and the Cognitive Fusion Questionnaire (CFQ). The participants were compensated with RMB of Chinese currency 10 yuan upon completion of the assessments. Oral consent was obtained from each participant. The research received ethical approval from the Human Research Ethics Committee of Huzhou University.

2.2. Measures

2.2.1. GMS

The GMS was developed by Dweck (2008) [36], and the Chinese version was revised by Jia (2018) [37]. The scale is used to measure the growth mindset level of respondents. The GMS consists of 20 items that measure two dimensions: respondents' fixed mindset (such as "Your intelligence is something very basic about you that you can't change very much" and "You are a certain kind of person, and there is not much that can be done to really change that") and growth mindset (such as "No matter how much intelligence you have, you can always change it quite a bit" and "You can always substantially change how intelligent you are"). A 4-point Likert scale was used to collect responses (0 = "Strongly Disagree," 1 = "Disagree," 2 = "Agree," and 3 = "Strongly Agree"). Higher scores on the scale indicated stronger orientations in the relevant dimension. During the data analysis, the growth-mindset items (i.e., 2, 3, 5, 6, 9, 10, 13, 18, and 19) and fixed mindset items (i.e., 1, 4, 7, 8, 11, 12, 14, 15, 16, 17, and 20) were separated. When calculating the average growth mindset score, the fixed mindset score was calculated in reverse order. We also calculated the average of all item scores, including growth mindset and reverse fixed mindset items. The scale had a Cronbach's alpha coefficient of 0.70 in this study.

2.2.2. APNI

The APNI was developed by Noguchi (2006) [23], and the Chinese version was revised by Lv (2016) [38]. This scale is used to measure differences in the individual's tendency to pay attention to, think about, or focus on positive (or negative) information. It is divided into two sub-scales: bias towards positive information (such as "I pay attention to positive things that other people do" and "I mostly remember times when I was happy") and bias towards negative information (such as "I can't forget the times I have performed poorly at something" and "I don't forget when others do things that hurt me"). Each item was calculated separately for the average score. The bias towards positive information had 19 items, and a 5-point Likert scale was used to collect the responses (1 = "Very Inconsistent," 2 = "Inconsistent," 3 = "Uncertain," 4 = "Consistent," and 5 = "Very Consistent"). The scale had a Cronbach's alpha coefficient of 0.88. The bias towards negative information had 11 items, and a 5-point Likert scale was used to collect responses (1 = "Very Inconsistent," 2 = "Inconsistent," 3 = "Uncertain," 4 = "Consistent," and 5 = "Very Consistent"). The scale had a Cronbach's alpha coefficient of 0.83.

2.2.3. CFQ

The CFQ was created by Gillanders (2010) [39] and revised by Zhang (2014) [18]. The scale retained only the Cognitive Fusion Sub-questionnaire (CFQ-F). Cognitive fusion is closely related to negative emotions and can be used to measure negative thoughts, negative self-evaluations, and incorrect self-perceptions. The scale has nine items and one dimension (such as "My thoughts cause me distress or emotional pain" and "I struggle with my thoughts"). A 7-point Likert scale was used to collect the responses (1 = "Very Inconsistent," 2 = "Inconsistent," 3 = "Somewhat Inconsistent," 4 = "In the Middle," 5 = "Somewhat Inconsistent," 6 = "Consistent," and 7 = "Very Consistent"). The scale had a Cronbach's alpha coefficient of 0.93.

2.3. Statistical analysis

The data were analyzed using SPSS 22.0. Pearson's correlation coefficient was used to test the correlations between growth mindset, bias towards positive information, bias towards negative information, and cognitive fusion. The parallel mediation test used the SPSS PROCESS macro bootstrapping method with 5000 bootstrap resamples and a 95 % bias-corrected confidence interval (CI) [40]. Hayes' PROCESS macro (Model 4) was employed to test for the existence of the mediating effects of bias towards negative and positive information on the association between growth mindset and cognitive fusion. A CI not including zero indicated a mediating effect. The significance level was set at $p < 0.05$.

3. Results

3.1. Preliminary analyses

The GMS uses a grading criterion. A score of 33 or above on the scale indicates a growth mindset, and a score of less than 33 indicates a fixed mindset. The descriptive statistics for the demographic information, growth mindset, bias towards positive information, bias towards negative information, cognitive fusion, and correlations between these variables can be found in Table 1. It is worth noting that the gender, SES and personal abilities did not form reliable relation with other variables (except an isolated positive relation between SES and growth mindset).

We found that growth mindset was positively correlated with bias towards positive information ($r = 0.314, p < 0.001$), negatively correlated with bias towards negative information ($r = -0.353, p < 0.001$) and negatively correlated with cognitive fusion ($r = -0.261, p < 0.001$). In addition, there was a significant positive correlation between the cognitive fusion and bias towards negative information ($r = 0.571, p < 0.001$).

3.2. Parallel mediation analysis

Gender, personal ability and SES were used as control variables in conducting the parallel mediation analysis. Growth mindset negatively predicted cognitive fusion and bias towards negative information while positively predicting bias towards positive information. Using cognitive fusion as the dependent variable and incorporating growth mindset, bias towards positive information, and bias towards negative information as predictors into the regression equation, the regression coefficient for growth mindset on cognitive fusion was no longer significant. The coefficient for bias towards positive information was not significant ($\beta = 0.038, t = 0.951, p = 0.342$), but that of bias towards negative information was significant ($\beta = 0.544, t = 13.397, p < 0.001$) (see Table 2). With regard to the results of the indirect effect test, the 95 % CI for the indirect effect of Path 1 [-0.068, 0.171] contained zero, and the indirect effect was statistically nonsignificant; the 95 % CI for the indirect effect of Path 2 [-1.089, -0.596] did not contain zero, the indirect effect was statistically significant, and the Effect = -0.837. The 95 % CI for the direct effect of a growth mindset on cognitive fusion [-0.697, 0.043] contained zero and was not significant for the direct effect. The indirect effect was significant only for Path 2 (see Fig. 1).

4. Discussion

This study aimed to examine whether a growth mindset indirectly predicted cognitive fusion through bias towards positive and negative information and to determine whether bias towards positive or negative information mediated this relationship. Growth mindset negatively predicted the cognitive fusion. Bias towards negative information mediated the relationship between growth mindset and cognitive fusion. However, the mediating role of bias towards positive information was not significant.

4.1. Effects of growth mindset to cognitive fusion

The hypotheses 1 was thus supported. One might expect that compared to individuals with a fixed mindset, individuals with a growth mindset are more “flexible”. In particular, individuals with a growth mindset are more adaptable to life’s difficulties and see them as learning opportunities, whereas individuals with a fixed mindset fear failure, continually falling into self-doubt when they fail [9–11]. Psychological inflexibility is a manifestation of cognitive fusion, which is reflected in the struggle to adapt to changes in life. Thus, growth mindset significantly and negatively predicted the cognitive fusion.

4.2. The mediating role of bias towards negative information

The results showed that growth mindset negatively predicted bias towards negative information and indirectly predicted cognitive

Table 1
Descriptive statistics and correlations (n = 470).

Variable	1	2	3	4	5	6
1SES	1					
2 PA	-0.020	1				
3 GM	0.105*	0.080	1			
4BPI	0.080	0.086	0.314***	1		
5BNI	-0.044	-0.072	-0.353***	-0.078	1	
6CF	-0.077	-0.066	-0.261***	-0.033	0.571***	1
Mean	2.40	3.67	1.65	3.98	3.31	4.69
SD	0.54	0.75	0.26	0.44	0.62	1.13
n	470	470	470	470	470	470

* $p < .05$; ** $p < .01$; *** $p < .001$.

SES: Socioeconomic Status, PA: Personal Ability, GM: Growth Mindset, BPI: Bias towards Positive Information, BNI: Bias towards Negative Information, CF: Cognitive Fusion.

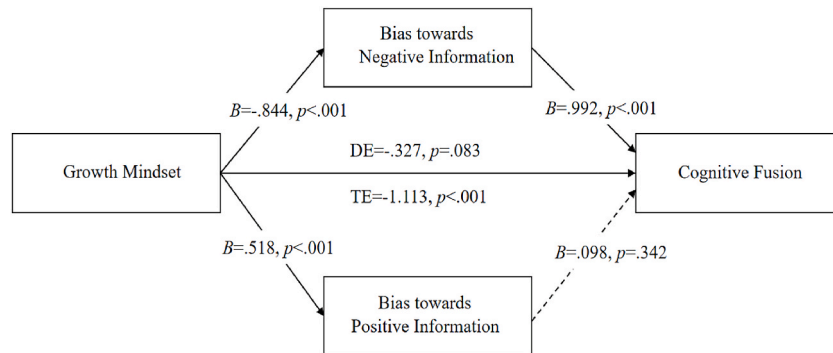
Table 2

Regression analysis of the relationship of variables in the parallel mediation model (n = 470).

Dependent Variable	Predictor Variable	R ²	F	B	β	t
CF	GM	0.075	9.430	-1.113	-0.252	-5.609***
BPI	GM	0.105	13.687	0.518	0.303	6.856***
BNI	GM	0.127	16.919	-0.844	-0.349	-7.987***
CF	GM	0.336	39.001	-0.327	-0.074	-1.737
	BPI			0.098	0.038	0.951
	BNI			0.992	0.544	13.397***

* $p < .05$; ** $p < .01$; *** $p < .001$.

GM: Growth Mindset, BPI: Bias towards Positive Information, BNI: Bias towards Negative Information, CF: Cognitive Fusion.

**Fig. 1.** Mediation effects of parallel mediation model. Unstandardized regression coefficients are shown.

Note. DE = Direct Effect, TE = Total Effect.

fusion via bias towards negative information, which confirmed hypotheses 2. The mediating effect of bias towards negative information was significant, consistent with previous findings [26,33]. However, the mediating effect of bias towards positive information was not significant. Growth mindset predicted cognitive fusion mainly via bias towards negative information. Bias towards negative information strongly predicted cognitive fusion. The explanation is probably that individuals with lower level of growth mindset are prone to being distracted by negative events [10]. Negative life events trigger bias towards negative information [31]. Individuals with greater bias towards negative information focus more intently on negative messages, resulting in increased levels of cognitive fusion [23].

Two possible explanations for the lack of mediation between a growth mindset and cognitive fusion by bias towards positive information can be considered. One reason is that individuals with a bias towards positive information tend to focus on the favorable aspects of events [23]. It is similar to the growth mindset, in which individuals with a growth mindset focus on the positive aspects of events and employ positive strategies when facing challenges [11,41,42]. The results of the study also showed that bias towards positive information was significantly and positively correlated with growth mindset. Another explanation may be linked to the individuals' protective mechanisms. According to evolutionary psychology [43], negative events are perceived to pose a greater threat to survival than positive events. Therefore, individuals who are less sensitive to negative messages may have lower chances of survival. In conclusion, the mediating role of bias towards positive information was not found to be as strong in this context.

4.3. Benefits of growth mindset for mental health

The study established the mediating effect of bias towards negative information and discussed potential reasons for the non-significant indirect effect of bias towards positive information. Our findings support the proposal of the benefits of a growth mindset on mental health. It is important to highlight the benefits of a growth mindset on mental health. A recent meta-analysis revealed that the effect of growth mindset intervention on mental health was significant ($d = 0.32$, 95% CI [0.10, 0.54]). The predictive interval for the intervention effect on mental health ranged from 0.07 to 0.57 [44]. Individuals with a growth mindset are more adept at viewing failures as learning opportunities, leading to better resilience and perseverance [9–11]. This adaptability to adversity helps in reducing anxiety and psychological distress [3]. Furthermore, a growth mindset also enhances an individual's self-efficacy [45] and well-being [42]. Taken together, a growth mindset positively impacts mental health by fostering a positive outlook, improving coping mechanisms for challenges, and assisting individuals in overcoming psychological difficulties.

5. Limitations and future research

This study has two notable strengths: the use of a substantial sample size and the implementation of meticulous mediation analysis.

However, certain limitations should be considered before generalizing the results of the study. First, in the current study we measured information bias using the APNI. This scale includes items that focus on the behavioral response to event (such as “I pay attention to positive things that other people do”) and lingering effect of attention bias that reflect higher level thoughts (such as “I mostly remember times when I was happy”). The concept of “attentional bias” often appears in behavioral literature involving experiments that involve measures of reflective response (due to modulation of exogenous or endogenous attention) triggered by physical stimuli (such as angry faces) [46–49]. For example, the dot-probe task and modified version of Posner Task [46], have all been used to measure attentional bias [48,49]. It is important to point out that the concept of “attentional bias” in the current study and in the original APNI is beyond the “attentional bias” manifested in behavior. The concept here applies to both low level response tendency and higher level (often repetitive) thoughts (or memory). In fact, a few studies directly used APNI to measure attentional bias [32,33] which measured attentional bias beyond those revealed through experimental methods. We made a minor adjustment to the name of the attentional bias and changed it from “attentional bias” to “information bias”.

Second, the gender ratio in our sample was not balanced, which could have influenced the final results. Participants in our study were college students and could not fully represent a larger population of healthy adults, let alone represent individuals with mental illness. Future studies should aim to obtain a balanced gender sample. Third, we suggest that future researchers use objective measures, such as the visual dot probe task, to measure attentional bias, which could help further verify whether attentional bias plays a mediating role between growth mindset and cognitive fusion.

6. Conclusion

The present study provided two key findings. First, growth mindset exhibits a negative predictive correlation with cognitive fusion. Essentially, an escalated GMS score corresponds to a diminished level of cognitive fusion. Second, bias towards negative information plays a mediating role in the relationship between growth mindset and cognitive fusion. By contrast, bias towards positive information does not mediate the relationship between growth mindset and cognitive fusion.

Declaration of ethical approval

This study was reviewed and approved by the Human Research Ethics Committee of Huzhou University, with the approval number: 20200811.

Data available statement

Data will be made available on request.

Funding

This work was supported by the Ministry of Education in China, Project of Humanities and Social Sciences (project no.18YJA760052).

CRediT authorship contribution statement

Dongchi Zhao: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Weidong Tao:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization. **Qiuchen Shen:** Writing – review & editing, Methodology. **Qingwen Zuo:** Writing – original draft. **Jingjing Zhang:** Writing – original draft. **Isabel Horton:** Writing – review & editing. **Zhen Xu:** Formal analysis. **Hong-Jin Sun:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://data.mendeley.com/datasets/hbjj56BCE62/1>.

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