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Exploring the Relationship Between Anxiety and Depression States and Attention Mechanisms in Chinese University Students

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Abstract. This study aims to explore the relationship between the symptoms of anxiety and depression and attention mechanisms in Chinese college students. This study employed a combined approach of questionnaires and experiments to test 30 Chinese university students. The questionnaires utilized the Chinese version of the Depression Anxiety Stress Scale-21 (DASS-21) and the Chinese version of the Attention Control Scale (ACS). The laboratory task was a computer-based key-press task, which included a dot-detection task, a classic Stroop task, and two emotion-specific Stroop tasks. The questionnaire results showed a positive link between anxiety/depression levels and attention shifting ability ($r = 0.756$, $p < 0.001$). This means people who reported higher emotional symptoms also felt their attention was more easily distracted. Analysis of laboratory experiment results found no significant group differences between participants with high and low symptoms. This was true for both attention bias scores in the dot-detection task and for interference effects in the classic Stroop task. However, the emotional Stroop task results were different. Low-symptom participants responded faster to negative words, while high-symptom participants showed the opposite pattern. This study suggests that the relationship between emotional symptoms and cognitive function may be first and most significantly reflected in the subjective perception and evaluation of the individual's own cognitive ability, while overt behavioral responses need to be further studied.

Keywords: Executive function, attention, anxiety, depression, adolescence

1. Introduction

When facing exams, some college students make detailed study plans for themselves, but not everyone follows them strictly. When experiencing high levels of anxiety, their ability to concentrate gets worse, so they often put things off or do poorly on their work. This shows that people struggle to use the higher thinking skills of executive function (EF) to control their behavior and stay on task. If they try to ignore social media while doing homework, or if they try to stay focused with distractions around, EF plays a crucial role. Individuals with anxiety and depression often have significant thinking problems, especially in organizing, planning, switching tasks, and sustained attention—these are all tied to EF issues [1].

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As a classic neurodevelopmental disorder, the core symptoms of attention deficit/hyperactivity disorder (ADHD)—hyperactivity, inattention, and impulsivity—are linked to executive function deficits [1]. Also, the rate of emotional disorders like anxiety and depression is very high in both clinical and subclinical ADHD groups [2]. This high comorbidity shows there are complex interactions between executive function, attentional control, and emotional states. However, even though more research is now looking at these connections, there is still not enough study on Chinese university students. This group deals with major academic and social pressures [3], so they need specific research. Therefore, this study aims to carefully examine the links between anxiety, depression, and basic attentional processes in Chinese university students.

EF are a series of higher-order cognitive processes. They are both crucial for "cool" systems like reasoning, and indispensable for managing emotions, motivation, and desires—areas called "hot" systems [4]. The core model of EF comprises three key parts: working memory, cognitive flexibility (or task switching), and inhibitory control. These parts support self-regulation and goal-directed behavior [5]. When these functions are impaired, an individual's emotional regulation abilities may falter. This might show as a reduced ability to suppress negative emotions or less responsiveness to positive cues. Thus, EF serves as a vital bridge connecting cognitive control systems to emotional well-being.

EF problems are one risk factor that makes people more likely to have mood disorders. Around the world, anxiety and depression are the two most common mental health problems for university students [6]. Anxiety mainly shows up as being overly watchful and constantly worried about possible danger, and it often comes with higher physical alertness. Depression, but is marked by lasting sadness, loss of pleasure, and slower or weaker thinking [7]. These disorders also impact daily life and are linked to specific thinking biases. Anxious people often pay more attention to threat-related signals, which shows a hyper-alert way of focusing [8]. Depression, but is more tied to a negative bias. For example, people may have trouble letting go of negative information and tend to repeatedly focus on pessimistic thoughts [9].

The link between emotion and EF works both ways. Emotional states can strongly affect thinking, often by disrupting focus controlled by prefrontal networks [10]. Evidence from tasks like the emotional Stroop task shows this: people are slower to name colors for negative words, meaning emotional content grabs attention and gets in the way of the task [11]. This emotional Stroop effect shows how emotional information intrudes on and disrupts cognitive control [12]. EF is thought to work to reduce this interference. However, studies suggest that cognitive control in a standard Stroop task may only partly counter emotional distraction [13]. Therefore, this study changes the standard Stroop task to involve participants' EF, emotional states, and attention at the same time.

Distinct states of emotion and cognition are not merely the products of individual psychological processing but also the outcomes of various social, economic, and cultural factors [14]. Existing research has shown links between emotional disorders and problems with EF and attention, but more study is needed. First, many studies have focused on Western clinical samples, paying insufficient attention to the specific non-clinical population of Chinese university students. Chinese university students face tough school competition, strong family pressure, and high job market stress. This specific environmental context likely makes the connection between emotional distress and alterations in EF. Second, past research has predominantly concentrated on the content of attention (e.g., biases towards negative stimuli), whilst investigations into how the capacity for attentional control—a core component of EF—within the mix of emotion and cognition are still not enough [15].

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The unique pressures on Chinese students lead to the hypothesis that their patterns of emotion-cognition interaction may possess distinctive characteristics. To accurately capture these potential differences, the present research employs a mixed-methods approach combining questionnaires and laboratory experiments. It collects both subjective self-report data and objective performance metrics from standardized behavioural tasks; within the experimental paradigm, it integrates emotional words, emotional faces, a dot-probe task, and a Stroop task in an attempt to understand the group's cognitive-affective processing tendencies. Through this multidimensional methods, this study aims to generate clearer and more real-world findings about the connections between emotional well-being and cognitive function within the Chinese student population. Furthermore, this study will use the Chinese versions of the Depression Anxiety Stress Scales-21 (DASS-21) and the Attentional Control Scale (ACS) [7,16], which can provide a basis for the wider application of these scales in China. For the experimental tasks, the classic Stroop task will be mixed with an emotional Stroop task [11,17], employing localised and standardised emotional stimulus materials from the "Chinese Affective Word System" and the "Chinese Facial Affective Picture System" [18,19]. The goal is to find the associations between states of anxiety and depression and EF, particularly their relationship with attentional control, within the Chinese cultural context.

To explore how anxiety and depression symptoms relate to EF, mainly attention control, this study suggests the following hypotheses:

Hypothesis 1 (H1): Anxiety and depression in students will be linked to their self-reported ability to shift attention. Specifically, higher scores on anxiety and depression measures are expected to correspond to higher scores on the self-assessed attentional shifting scale.

Hypothesis 2 (H2): In the dot-probe task, participants reporting higher levels of anxiety and depression will show an enhanced attentional bias towards emotional faces. Behaviourally, this bias should be observable as faster reaction times when the probe is spatially congruent with an emotional (happy or sad) face, compared to a neutral face cue.

Hypothesis 3 (H3): For the classic colour-word Stroop task, this study expect that increasing symptom severity of anxiety and depression will be associated with a larger Stroop interference effect. Operationally, this means a greater difference in reaction times between incongruent trials (e.g., the word 'BLUE' printed in red) and congruent trials (e.g., "BLUE" in yellow), which is interpreted as an index of weaker inhibitory control.

Hypothesis 4 (H4): For the emotional words Stroop task, individuals with elevated symptoms will take significantly longer to name the colour of emotionally words (e.g., "sad", "failure") than neutral words (e.g., "table", "window"). Such a slowdown would indicate an affective interference effect, where task-irrelevant emotional meaning disrupts the primary cognitive task of colour identification.

Hypothesis 5 (H5): In the emotional picture–Stroop variant, this study hypothesise that preceding a Stroop trial with an emotional face prime will amplify interference effects. Specifically, participants scoring higher on anxiety and depression measures are predicted to show slower colour-naming speeds on trials that follow emotional face primes, relative to trials following neutral face primes.

2. Method

2.1. Participants

This study enrolled thirty-five undergraduate volunteers from China Three Gorges University. Prior to engaging in the study procedures, formal consent was secured from each participant. During the

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initial data screening phase, task performance was evaluated based on trial accuracy. Individuals whose overall accuracy fell below the 80% threshold were excluded from subsequent stages of analysis. The resultant final cohort comprised thirty participants (11 males, 19 females), averaging 20.9 years of age (SD = 2.325). Every participant in this final sample confirmed having normal or corrected to normal vision, no prior diagnosis of colour blindness or related visual impairments, and right-hand dominance. These criteria were established to reduce potential confounding influences from perceptual or motor asymmetries and to enhance the reliability of the collected behavioural data.

2.2. Materials

This study used 5 materials in total. The first one is a demographic questionnaire, which is used to collect information on participants' gender, age, grade, major, and place of household registration. To indicate the participants' emotional state, this study used the Chinese Version of the DASS-21. It has three subscales for depression, anxiety, and stress, with 7 items each, making 21 items total [7]. To measure individuals' self-perceived flexible shifting of attention, this study employed the attention shifting subscale from the Chinese Version of ACS, consisting of 11 items (items 1, 2, 3, 6, 7, 8, 11, 12, 15, 16, 20) [16]. In addition, this study utilized some emotional word materials, selected from the "Chinese Affective Word System" [18]. There were 12 positive emotional words (e.g., fortunate, happy), 12 negative emotional words (e.g., sad, painful), and 24 neutral words (e.g., table, material). Finally, this study used emotional facial pictures from the "Chinese Facial Affective Picture System" [19]. Twelve happy faces, twelve sad faces, and twenty-four neutral faces were chosen, with equal numbers of male and female faces.

2.3. Experimental design

This study employed a cross-sectional design combining questionnaire and experimental methods. All experimental procedures were presented using the psychology experiment programming software PsychoPy (v2025.2.1 for macOS). Participants were tested individually in a quiet laboratory, first completing the questionnaires on a mobile phone, followed by four experimental tasks presented in a fixed order on a computer.

Experiment 1is Dot-Probe Task with emotional faces. This task measured participants' attentional bias towards emotional stimuli within a spatial orienting paradigm. Each trial started with a central fixation cross "+". Following this, two facial expression images, one neutral and one emotional (either sad or happy), appeared simultaneously on the left and right sides of the screen. Upon the disappearance of these faces, a probe stimulus "*" replaced one of the two previous image locations (see Figure 1). Participants were required to indicate the probe's location (left or right) by pressing the corresponding key with both speed and accuracy. The experiment consisted of 40 trials in total.

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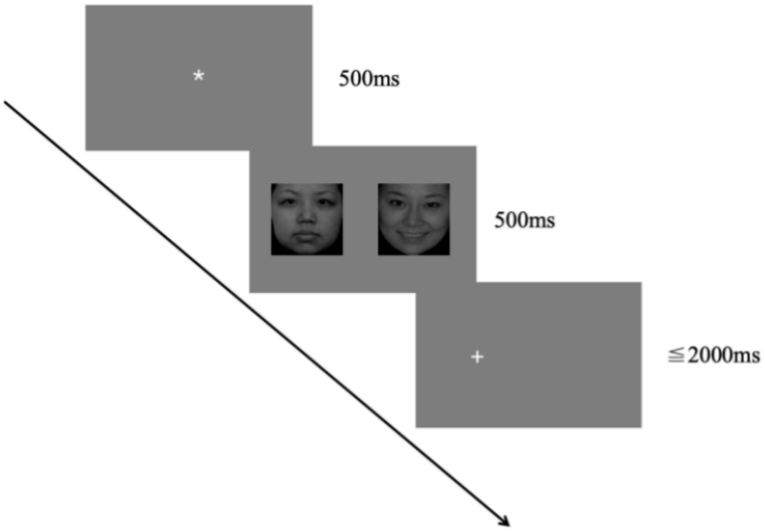

Figure 1. A single trial in the dot-probe task with emotional faces. The sequence of presentation is fixation point, emotional face pair (neutral–emotional), target stimulus

Experiment 2 is Classical Stroop Task. This task assessed individuals' inhibitory control ability. A color word (e.g., "red", "yellow", "blue") was displayed on the screen, as shown in Figure 2. The ink color might be congruent with the word meaning (e.g., the word "red" printed in red ink) or incongruent (e.g., the word "blue" printed in yellow ink). Participants needed to ignore the word's meaning and only judge the ink color of the word: red (left key), yellow (up key), blue (right key). This task consisted of 48 trials.

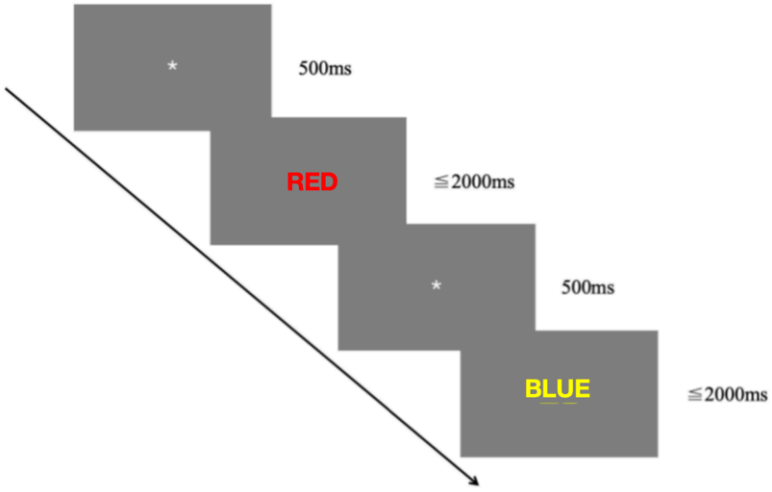

Figure 2. Two trials in the classical Stroop task. The sequence of presentation is fixation point, color word

Experiment 3 is Emotional Words Stroop Task. This task assessed the interference of emotional information on cognitive processing. An emotional word (positive, neutral, or negative) printed in different colored ink was displayed on the screen, as shown in Figure 3. Participants needed to ignore the word's color and only judge the emotional valence of the word: positive word (left key), neutral word (up key), negative word (right key). This task consisted of 48 trials.

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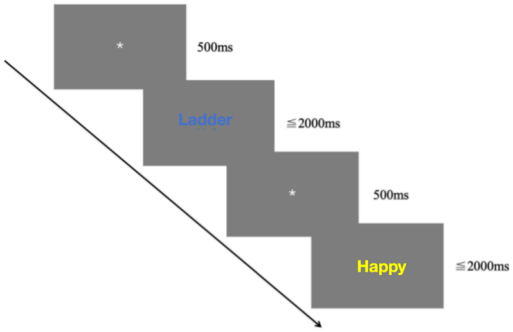

Figure 3. Two trials in the emotional words Stroop task. The sequence of presentation is fixation point, emotional word

Experiment 4 is Emotional Picture Stroop Task. This task combined emotional context with cognitive conflict to investigate the impact of emotional background on EF. Each trial proceeded as follows: First, a fixation point was presented, followed by an emotional face picture (happy, sad, or neutral) serving as an emotional priming background stimulus. After, a color-word from the classical Stroop task was presented, as shown in Figure 4. The participant's task was identical to Experiment 2: ignore the meaning of the word and respond to its ink colour. (red: left key, yellow: up key, blue: right key). This task consisted of 48 trials.

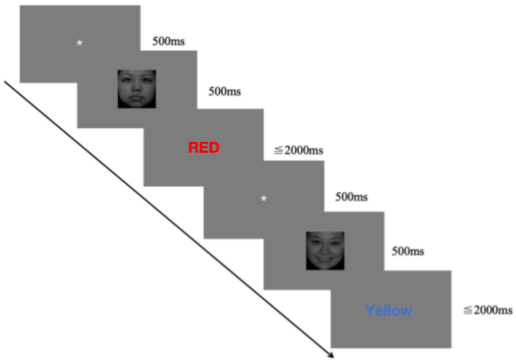

Figure 4. Two trials in the emotional picture Stroop task. The sequence of presentation is fixation point, emotional face, color word

3. Results

3.1. Participants and grouping

The final sample comprised 30 participants (19 female, 11 male) with a mean age of 20.9 years (SD = 2.33). The participants' mean total score on the DASS-21 was 33.80 (SD = 8.09), with the depression subscale mean score being 10.87 (SD = 3.05) and the anxiety subscale mean score being 9.43 (SD = 2.03). On the attention shifting subscale of the ACS, the mean score was 24.50 (SD = 6.89). Using the median of the DASS total score (35) as a cutoff, participants were classified into high (N = 15) and low (N = 15) emotional-symptom groups to examine differences in cognitive tasks.

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3.2. Correlation between anxiety/depression and self-reported attentional shifting

Correlational analysis results supported the research hypothesis 1. Pearson correlation analysis revealed a highly significant positive correlation between self-reported attention shifting ability (ACS score) and emotional symptom levels, showing on Table1. Specifically, ACS scores were significantly positively correlated with DASS total score ($r = 0.756$, $p < 0.001$), depression subscale score ($r = 0.749$, $p < 0.001$), anxiety subscale score ($r = 0.574$, $p < 0.001$), and stress subscale score ($r = 0.589$, $p < 0.001$). This indicates that individuals reporting more severe anxiety/depression symptoms tended to report having stronger attentional shifting ability.

Table 1. Pearson correlations between attention control and emotional symptom measures (N = 30)

	ACS	DASS	DASS_depression	DASS_anxiety	DASS_stress
ACS	1	.756**	.749**	.574**	.589**
DASS	.756**	1	-	-	-
DASS_depression	.749**	-	1	-	-
DASS_anxiety	.574**	-	-	1	-
DASS_stress	.589**	-	-	-	1

Note. ACS = score of Attentional Control Scale_attention shifting; DASS = score of Depression, Anxiety and Stress Scales-21.

** $p < .01$.

3.3. Attentional bias toward emotional faces in the dot-probe task

Independent samples t-test results did not support the research hypothesis. For the dot-probe task, the difference in attentional bias scores (Target Effect) between the high emotional symptom group ($M = 3.45$, $SD = 3.24$) and the low group ($M = 2.30$, $SD = 1.68$) did not reach statistical significance ($t(20.98) = -1.221$, $p = 0.236$, 95% CI [-3.11, 0.81]). Therefore, it was not confirmed that individuals with high anxiety/depression exhibited stronger spatial attentional bias toward emotional faces.

3.4. Stroop interference effect in the classical Stroop task

Independent samples t-test results similarly did not support the research hypothesis. In the classical Stroop task, the Stroop interference effect shown by the high group ($M = 2.71$, $SD = 2.52$) was not significantly different from that of the low group ($M = 1.69$, $SD = 1.03$) ($t(18.52) = -1.453$, $p = 0.163$, 95% CI [-2.49, 0.45]). This indicates that, within this sample, individuals with higher anxiety/depression symptoms did not show significantly stronger inhibitory control deficits.

3.5. Emotional Stroop effect

Analysis results revealed a set of non-significant but directionally interesting trends. First, a paired t-test on the full sample indicated no significant difference in color identification reaction times between positive and negative words ($t(29) = 0.505$, $p = 0.617$). Direct comparison of the emotional interference effect size between the two groups also showed no difference ($t(24.28) = 1.132$, $p = 0.269$). However, within-group paired t-tests revealed a potential pattern dissociation: the low-symptom group named the colors of negative words faster ($M = 9.45$) than those of positive words

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(M = 9.89), an opposite pattern was observed in the high-symptom group, naming colors of negative words slower (M = 10.13) than positive words (M = 9.96), although neither within-group difference reached statistical significance (lower group p = 0.159; higher group p = 0.714).

3.6. Modulation of Stroop interference by emotional face primes

All analysis results failed to support the research hypothesis. For all participants, under negative and positive picture-elicited conditions, no significant difference was observed in reaction times (t (29) = -0.124, p = 0.902). The high and low groups showed no difference in picture priming effect size (t (21.36) = -0.201, p = 0.843). Within-group paired comparisons were also non-significant for both groups (higher group p = 0.965; lower group p = 0.737). This suggests that the preceding emotional face pictures did not significantly exacerbate the interference effect in the subsequent Stroop task.

4. Discussion

The objective of this research is to investigate the relationship between anxiety, depression, and core attentional mechanisms in Chinese university students. Questionnaires showed a strong negative link between emotional symptoms and self-reported attention control, yet performance across multiple behavioural tasks did not major significant differences in EF between participants with high and low levels of emotional symptoms.

To answer the research questions, a multi-method approach was adopted, combining self-reports with four laboratory-based computerised tasks. Emotional symptoms and perceived attentional control were assessed using the DASS-21 and the ACS, respectively, to examine Hypothesis 1 (H1). Participants then completed four behavioural tasks in this order: (1) a dot-probe task (H2); (2) a classic Stroop task (H3); (3) an emotional words Stroop task (H4); and (4) an emotional facial picture Stroop task (H5).

Support for H1 challenges the common idea that emotional problems directly lower cognitive capacity. This finding shows a difference between what people report about themselves and how they actually perform on tests. Questionnaires about self-rated thinking often measure broad, stable self-views. These views can be strongly affected by a person's mood in recent weeks. On the other hand, behavioral tasks measure real performance under controlled, short-term conditions. This difference suggests that more emotional symptoms may mainly change a person’s belief about their own attention control, but not cause a real loss in their ability to do tasks

Regarding the behavioural results, neither H2 nor H3 received empirical support. One good explanation for these null findings lies in the type of the study’s sample. Participants were university students, not a clinical group. This means their reported levels of anxiety and depression, while varied, were mostly in the normal range. Such levels may be insufficient to produce clear, widespread deficits in task performance [20]. Secondly, all participants were recruited from one single university, and the sample size was small; both factors indicate the data may not be representative. Furthermore, the interference generated in a standard Stroop task is primarily cognitive in nature and may not strongly engage emotional processing systems. This interpretation aligns with research by Straub et al., who propose that cognitive control and emotional processing are, to some degree, functionally independent systems [1].

However, the data for H4 was not statistically significant. However, the pattern is interesting. Participants with fewer symptoms named the colors of negative words a bit faster. Those with more symptoms showed the opposite trend and were slower. This suggests that an individual’s level of emotional symptoms might affect their basic attention to emotional material. In simple terms,

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individuals with higher anxiety or depression might find it harder to ignore negative information. This then slows them down when they must ignore the word's meaning and only respond to its color. Confirming this idea will need studies with more people to get clear results.

The lack of a significant effect for H5 could mean that, in a simple task like colour-naming, a briefly flashed emotional face is not strong enough to meaningfully alter the cognitive conflict experienced in the very next Stroop trial. Future studies could explore this interaction using methods better suited to capturing momentary emotional engagement. For example, fMRI could be used to check if emotional face primes activate brain regions like the amygdala. It could also see if this activation predicts performance on the following trial. Another approach would be to use tasks where emotional and cognitive features are combined from the start—such as having to name the colour of a word that is itself an emotional face—which might create a stronger competition for attention and show clearer interactions.

To sum up, this study found a notable dissociation: while students reported experiencing attentional problems in their daily life, no corresponding deficits in attentional control were evident in our laboratory-based measures of EF. Several important caveats must be considered. Firstly, as this was a cross-sectional study, it cannot tell if emotional symptoms lead to perceived cognitive difficulties, or if thinking problems cause emotional symptoms. Secondly, this study's ability to detect small but real effects was constrained by the limited sample size of this study. To learn more, future studies should try a longitudinal approach. This would allow tracking changes over time in a larger group. The study also needs to create better tasks. These tasks should be more true to real life and more demanding, to properly test the specific skills people are studying. Also, adding physical measures like EEG could give useful details about the brain activity behind thinking control and emotional processing.

5. Conclusion

This study used a mixed-methods approach to investigate the relationship between states of anxiety and depression and core attentional mechanisms in Chinese university students. The idea that emotional symptoms link to self-reported attention shifting (H1) was strongly supported. However, the objective tasks did not support the other ideas. They did not show that more symptoms lead to greater attention bias (H2), more Stroop interference (H3), or more emotional priming interference (H5). A small, non-significant trend was seen for H4. Here, people with lower and higher symptoms showed opposite patterns when dealing with emotional versus neutral words. This hints they might process information differently. In the end, the results suggest that for students who are not patients, emotional symptoms mainly change how they personally feel and judge their own thinking control. Based on this, future help efforts could test if changing a person's beliefs about their attention, or training to better manage emotions (like with mindfulness), might reduce distress and also lead to a more helpful and true view of their cognitive abilities.

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