The Effect of Rumination on Social Anxiety: The Role of Negative Self-Beliefs

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Abstract

How ruminative thinking influences social anxiety via its impact on negative self-beliefs represents a critical issue that remains to be thoroughly examined in current cognitive models of social anxiety. Building upon this, the present study systematically investigated the mechanisms linking ruminative thinking, negative self-beliefs, and social anxiety through two experiments. Experiment 1 utilized a state induction task to observe changes in negative self-beliefs and social anxiety levels following ruminative thinking. The findings demonstrated that ruminative thinking maintains elevated social anxiety by delaying the extinction of negative self-beliefs. Experiment 2 collected participants' autobiographical memories of social anxiety and associated beliefs, attempted to intervene on negative self-beliefs through cognitive reappraisal, and examined its effects on social anxiety across different psychological states. The results revealed that intervening on negative self-beliefs within a ruminative state effectively alleviates social anxiety. Overall, this study elucidates the mechanism through which negative self-beliefs mediate the effect of ruminative thinking on social anxiety, thereby extending the cognitive model of social anxiety and providing valuable theoretical foundations and empirical support for interventions aimed at reducing social anxiety.

Full Text

The Effects of Rumination on Social Anxiety: The Role of Negative Self-Beliefs

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Abstract

How rumination influences social anxiety by affecting negative self-beliefs is a key issue that remains to be thoroughly explored in current cognitive models of social anxiety. Based on this, the present study systematically investigated the mechanisms underlying the relationships among rumination, negative self-beliefs, and social anxiety through two experiments. Experiment 1 employed a state induction task to observe changes in negative self-beliefs and social anxiety levels following rumination. The results revealed that rumination maintains high levels of social anxiety by delaying the extinction of negative self-beliefs. Experiment 2 collected participants' autobiographical memories of social anxiety and related beliefs, attempting to intervene in negative self-beliefs through cognitive reappraisal and examining its effects on social anxiety under different psychological states. The findings demonstrated that intervening in negative self-beliefs during rumination states can effectively alleviate social anxiety. Overall, this study elucidates the mechanism through which negative self-beliefs mediate the effect of rumination on social anxiety, further extending the cognitive model of social anxiety and providing effective theoretical foundations and empirical support for the intervention and improvement of social anxiety.

Keywords: Social anxiety, Rumination, Negative self-beliefs, Cognitive model of social anxiety, Cognitive reappraisal

Classification Code: B842

Introduction

Social anxiety is a common anxiety disorder that generally refers to anxiety triggered by social or interpersonal situations, typically manifesting as excessive worry and fear of negative evaluation from others (Stein & Stein, 2008). When such emotions exceed normal thresholds and cause persistent distress to individuals, it is defined as social anxiety disorder, also known as social phobia, characterized by recurrent and intense anxiety responses to social situations where evaluation by others may occur (American Psychiatric Association, 2013). Social anxiety is generally accompanied by noticeable emotional changes or somatic symptoms, such as fear, rapid heartbeat, sweating, trembling, and can severely impact an individual's learning, work, and daily life. In fact, even when not meeting clinical diagnostic criteria, experiencing subthreshold or subclinical social anxiety can lead to significant cognitive impairments (Fehm et al., 2008).

Young populations are particularly vulnerable to social anxiety. Research indicates that approximately 90% of social anxiety symptoms emerge before age 23 (Kessler et al., 2005). In recent years, with socioeconomic development and changes in life pace, the prevalence of social anxiety among Chinese residents has been continuously rising. Surveys report that the average incidence of social anxiety symptoms among Chinese children, adolescents, and young adults is 23.5% (Tang et al., 2022), with adolescent social anxiety levels showing a year-by-year increasing trend from 2002 to 2020 (Xin et al., 2022). Additionally, a

cross-national survey spanning seven countries (including China) revealed that the prevalence of social anxiety among young people is significantly higher than previously reported, with over one-third of respondents (36%) meeting the standard diagnostic threshold for social anxiety disorder (Jefferies & Ungar, 2020). Currently, social anxiety has become a primary factor in adolescent anxiety disorders (La Maison et al., 2018), making research on social anxiety crucial for preventing and mitigating more severe mental health problems. Deepening our understanding of the factors that contribute to the onset and maintenance of social anxiety can facilitate the development of effective prevention measures and intervention strategies, thereby improving mental health and social adaptation capabilities in key populations.

Theoretical Framework

Theoretical models of social phobia propose that individuals with social anxiety have a tendency to engage in negative rumination following social events or interactions, with this post-event rumination representing one of the primary processes that maintain social anxiety (Clark & Wells, 1995). Rumination typically manifests as repetitive, passive recollection, contemplation, and analysis of problems during negative emotional states, representing a negative cognitive appraisal style toward distressing events. Rumination is not only associated with emotional problems such as anxiety, depression, and sadness but can also lead to sleep disturbances, impaired memory and executive control functions, cognitive dysregulation, and affect problem-solving and interpersonal adaptation (Watkins & Roberts, 2020). Particularly among individuals with social anxiety, rumination tends to be recurrent and intrusive, causing individuals to repeatedly review social events, triggering anxiety and negative cognitions related to self-perception, which in turn leads to avoidance and withdrawal behaviors (Abbott & Rapee, 2004). Over time, persistent rumination causes individuals to maintain negative views of their performance and may even distort actual memories to intensify the degree of negative evaluation, leading individuals to continuously maintain or even exacerbate anxiety symptoms and negative emotions (Morgan & Banerjee, 2008).

In theoretical research on social anxiety, numerous explanations have been proposed regarding its development and maintenance (Heimberg et al., 2010; Wong & Rapee, 2016), with these theories commonly emphasizing the role of cognitive factors. In social situations, people sometimes develop distorted beliefs about themselves and how others evaluate them. These negative, maladaptive beliefs are termed negative self-beliefs and represent a core feature of social anxiety (Clark & Wells, 1995). Clark and Wells (1995) proposed that maladaptive self-beliefs cause individuals with social anxiety to continuously experience panic during social performance and trigger anxiety. They further categorized these self-beliefs into three distinct types: (a) excessively high standards for social performance (e.g., "I must make a good impression on everyone"); (b) conditional beliefs about social evaluation (e.g., "If people see me anxious, then they will

look down on me"); and (c) unconditional beliefs about the self (e.g., "People will think badly of me").

Negative self-beliefs amplify individuals' perceived negative emotional experiences in social situations (such as anxiety, fear, worry), triggering excessive emotional responses (Heimberg et al., 2014), leading to maladaptive behaviors (such as social avoidance) and causing cognitive-affective dysregulation (Heeren et al., 2020), thereby further maintaining or exacerbating social anxiety (Campbell-Sills & Barlow, 2007). Research has found that individuals with social anxiety tend to have higher levels of negative self-beliefs (Hofmann, 2007; Schulz et al., 2008).

Building upon this foundation, Hofmann (2007) proposed a cognitive model of social anxiety. This theory suggests that one reason individuals with social anxiety worry in social situations is that they hold excessively high social standards. Individuals with social anxiety expect to make a special impression on others yet doubt their ability to do so, possibly because they cannot clearly define their goals and select implementable behavioral strategies to achieve them. This leads to further increases in social worry and self-focused attention, triggering additional cognitive processes such as exaggerating the likelihood of negative outcomes in social situations and overestimating potential social costs. To avoid making mistakes in social settings, individuals with social anxiety may adopt maladaptive coping strategies, including avoidance and safety behaviors, followed by post-event rumination, which further exacerbates their psychological burden. Therefore, based on the cognitive model of social anxiety and in conjunction with the aforementioned theoretical model of social phobia, this study hypothesizes that during rumination, individuals consolidate and deepen negative cognitive biases about their social performance, reinforcing maladaptive negative self-beliefs, which in turn leads to the maintenance of social anxiety.

Literature Review and Current Study

Although the important role of rumination in triggering and maintaining mental illnesses such as depression and anxiety has been extensively discussed (Watkins & Roberts, 2020), limited research has focused on the relationship between rumination and social anxiety as a specific type of anxiety. Constrained by small sample sizes and inconsistent measurement tools, previous research findings have not been entirely consistent. However, most studies have reported a positive correlation between rumination and social anxiety (Brozovich et al., 2015; Kocovski et al., 2011; Wong & Moulds, 2012). Building on this foundation, a recent meta-analysis found that rumination plays a critical role in maintaining social anxiety, with higher levels of rumination corresponding to more severe social anxiety symptoms ($r = 0.45$) (Edgar et al., 2024).

Furthermore, although the concept of negative self-beliefs has long been mentioned theoretically, corresponding quantitative research has only recently emerged (Wong et al., 2017; Wong & Moulds, 2011). Subsequent studies

have found that rumination occurring before or after events activates different types of self-beliefs (Wong & Moulds, 2009), and baseline rumination levels can predict subsequent levels of negative self-beliefs (Wong & Moulds, 2012), indicating that rumination further deepens or consolidates the degree of negative self-beliefs. Meanwhile, research has shown that negative self-beliefs are moderately to strongly positively correlated with the severity of social anxiety (Gkika et al., 2018; Wong et al., 2021; Wong et al., 2014) and are associated with cognitive and behavioral avoidance exhibited in social anxiety (Heeren et al., 2020; Wong & Moulds, 2011). A 12-week cognitive-behavioral therapy study found that negative self-belief levels decreased with treatment, and their changes could significantly predict changes in social anxiety, whereas reductions in social anxiety could not significantly predict changes in self-beliefs (Gregory et al., 2018). This result aligns with the cognitive model of social anxiety, suggesting that cognitive change should precede symptom reduction and emphasizing the important role of negative self-beliefs in the development and change of social anxiety.

However, due to relatively limited perspectives, existing research typically examines rumination, negative self-beliefs, and social anxiety separately, often investigating only the pairwise relationships (such as rumination and social anxiety, negative self-beliefs and social anxiety, or rumination and negative self-beliefs). Only one study has used self-report methods to investigate the interrelationships among all three (Kissell et al., 2016), lacking more systematic and in-depth exploration. Additionally, existing research has focused primarily on individuals with social anxiety disorder, viewing rumination and negative self-beliefs as consequences of social anxiety that interact with it to form a vicious cycle. Although these findings have made important contributions to explaining thought patterns in social anxiety, they have overlooked the possibility that general populations and subclinical groups face similar difficulties (Jefferies & Ungar, 2020). Therefore, expanding the research population to include the general public is necessary, as this can provide more comprehensive insights into the mechanisms underlying the relationships among these three factors and offer more diverse perspectives for prevention and intervention strategies for social anxiety.

Figure 1 [Figure 1: see original paper] Theoretical model of the present study. Note: - represent path relationships supported by previous research. Rumination is positively correlated with social anxiety and can predict social anxiety (Bean & Ciesla, 2024; Jose et al., 2012); Rumination can maintain and predict negative self-beliefs (Wong & Moulds, 2009, 2012); Negative self-beliefs are positively correlated with social anxiety, and their changes can predict symptom changes in social anxiety (Gregory et al., 2018); Negative self-beliefs mediate the relationship between rumination and social anxiety (Kissell et al., 2016).

Hypotheses

In summary, this study aims to answer how rumination maintains social anxiety by influencing negative self-beliefs and to explore whether intervening in

negative self-beliefs can effectively alleviate social anxiety. The research focuses specifically on the effects of post-event rumination; therefore, anticipatory rumination was not included to avoid complicating the experimental context and to ensure that the focus remains on key concepts. Hereinafter, rumination refers specifically to post-event rumination. The study employs experimental manipulation methods to better observe the effects of rumination states on negative self-beliefs and social anxiety. Experiment 1 aims to verify the mediating role of negative self-beliefs in the relationship between rumination and social anxiety by observing changes in individuals' negative self-beliefs and social anxiety levels under rumination states in the laboratory, thereby revealing the dynamic relationships and mechanisms among the three variables. Based on the findings of Experiment 1, Experiment 2 further investigates whether intervening in negative self-beliefs can effectively alleviate social anxiety, evaluates the effectiveness of using cognitive reappraisal as an intervention method, and validates and extends the conclusions of Experiment 1. This study proposes the following hypotheses: (1) There are significant positive correlations among rumination, social anxiety, and negative self-beliefs; (2) Negative self-beliefs can mediate the relationship between rumination and social anxiety, with rumination exacerbating or maintaining social anxiety levels by reinforcing negative self-beliefs; (3) Intervening in negative self-beliefs can reduce the impact of rumination on social anxiety.

Experiment 1

Participants

Sample size was estimated using G*Power 3.1. For the statistical tests employed in this experiment, with a significance level set at $\alpha = 0.01$, desired power of 1 -β = 0.80, and medium effect size of f = 0.25 (Wong & Moulds, 2009), the required sample size was no fewer than 52. This study recruited 94 university students with no history of mental illness (no history of brain injury, schizophrenia, major depression, anxiety disorders, or insomnia), who were right-handed and had normal or corrected-to-normal vision. Among them, one participant refused to give the speech, five participants quit during the speech, one participant failed to complete all measurements, one participant reported inability to understand and follow the instructions, and three participants did not complete the entire experimental procedure as instructed. After excluding these participants, data from a total of 83 participants were included in subsequent analyses, comprising 26 males and 57 females with a mean age of 21.05 $\pm$ 2.15 years. All participants received monetary compensation after the experiment. The study was approved by the Ethics Committee of the Faculty of Psychology at Southwest University.

Materials and Procedure

Upon arrival at the laboratory, participants completed a baseline measurement, followed by a timed speech task. Participants randomly selected a controversial topic as their speech theme, prepared for 1 minute, and then delivered a 3-minute timed speech. Extended periods of silence were not permitted before the timer ended. Participants were informed that their speech would be video-recorded throughout and evaluated by professionals. Subsequently, all participants were randomly assigned to two groups for the state induction task. This experiment utilized paradigms and materials from previous studies to induce rumination (Burkhouse et al., 2017). Each group' s materials comprised 45 items, presented via E-prime 2.0 for 8 minutes. In the experimental group (rumination state), these sentences guided participants to reflect on their emotional states, physical and mental feelings, personal characteristics, etc., such as "Think about: What does your current feeling mean?" and "Think about: What is your character and personality like in the eyes of others?" For the control group (distraction state), these sentences directed participants to think about concrete objects unrelated to the current situation—common things in daily life without strong emotional connotations that participants could imagine based on their personal experiences, such as "Think about: A group of polar bears fishing in a stream." Following the speech and state induction tasks, changes in participants' social anxiety, rumination, and negative self-belief levels were recorded using the following scales:

(1) **State-Trait Anxiety Inventory (STAI).** This study used the State-Trait Anxiety Inventory (Marteau & Bekker, 1992) to measure changes in participants' social anxiety. The scale includes 20 items scored on a 4-point Likert scale, where 1–4 represent "not at all" to "very much so." Items 1, 2, 5, 8, 10, 11, 15, 16, 19, and 20 are reverse-scored. Higher scores indicate higher current anxiety levels.

(2) **Brief State Rumination Inventory (BSRI).** This study used the Brief State Rumination Inventory to measure participants' state rumination (Marchetti et al., 2018; Wang et al., 2022). The scale includes 8 items, each rated on a 0–100 scale ("strongly disagree" to "strongly agree"). Higher scores represent stronger state rumination levels.

(3) **Self-Beliefs Related to Social Anxiety Scale (SBSA).** This study used the Self-Beliefs Related to Social Anxiety Scale (Wong et al., 2014) to measure participants' negative self-beliefs associated with social anxiety. The scale includes three dimensions: high standards beliefs, unconditional beliefs, and conditional beliefs, comprising 15 items total. Scoring employs an 11-point Likert scale, where 0–10 represent "do not agree at all" to "completely agree." Higher scores indicate higher levels of negative self-beliefs related to social anxiety.

Results

Manipulation Check for Social Anxiety

A paired-samples t-test was conducted on anxiety levels measured before and after the speech task. Results revealed that post-speech anxiety levels (48.15 ± 10.15) were significantly higher than pre-speech levels (39.15 ± 10.29), $t(82) = 8.47$, $p < 0.001$.

Randomization Check

Independent-samples t-tests were conducted on anxiety, state rumination, and negative self-belief levels between the experimental and control groups at the time of group assignment. Results showed no significant differences in these measures across groups, confirming successful randomization and no significant baseline differences between the two groups. Specific results are presented in Table 1 .

Table 1 Analysis of Differences Across Dimensions by Group

Group	State Rumination	Negative Self-Beliefs	Social Anxiety Level
Experimental Group (N = 42)	356.19 ± 175.78	62.26 ± 22.70	48.00 ± 9.13
Control Group (N = 41)	397.17 ± 174.18	56.27 ± 22.15	48.29 ± 11.21

Manipulation Check for State Induction Task

A 2 (time: pre-test, post-test) × 2 (group: experimental, control) repeated-measures ANOVA was conducted on participants' state rumination levels. Results revealed a significant main effect of time, $F(1, 81) = 28.89$, $p < 0.001$, $^2 = 0.26$; a marginally significant main effect of group, $F(1, 81) = 3.80$, $p = 0.055$, $^2 = 0.05$; and a significant time × group interaction, $F(1, 81) = 71.98$, $p < 0.001$, $^2 = 0.47$. Simple effects analysis found that at pre-test, the main effect of group was not significant, $F(1, 81) = 1.414$, $p = 0.29$; at post-test, the main effect of group was significant, $F(1, 81) = 26.15$, $p < 0.001$, $^2 = 0.24$, with state rumination levels in the control group significantly lower than in the experimental group. This indicates that changes in state rumination over time were influenced by group assignment, meaning that the different manipulations in the experiment produced different effects on participants' state rumination, thereby demonstrating the effectiveness of the manipulation. See Figure 2 [Figure 2: see original paper].

Figure 2 [Figure 2: see original paper] Changes in rumination levels before and after state manipulation. Note: *** indicates $p < 0.001$

Effects of Rumination on Negative Self-Beliefs

A 2 (time: pre-test, post-test) × 2 (psychological state: rumination, distraction) repeated-measures ANOVA was conducted on participants' negative self-belief levels. Results revealed a significant main effect of time, $F(1, 81) = 41.50$, $p < 0.001$, $^2 = 0.34$; a marginally significant main effect of psychological state, $F(1, 81) = 3.92$, $p = 0.051$, $^2 = 0.05$; and a significant time × psychological state interaction, $F(1, 81) = 7.87$, $p = 0.006$, $^2 = 0.09$. Simple effects analysis found that at pre-test, the main effect of psychological state was not significant, $F(1, 81) = 1.48$, $p = 0.23$; at post-test, the main effect of psychological state was significant, $F(1, 81) = 7.27$, $p = 0.009$, $^2 = 0.08$, with negative self-beliefs in the distraction state significantly lower than in the rumination state. See Figure 3 [Figure 3: see original paper].

Figure 3 [Figure 3: see original paper] Effects of rumination on negative self-beliefs. Note: *** indicates $p < 0.001$

Effects of Rumination on Social Anxiety

A 2 (time: pre-test, post-test) × 2 (psychological state: rumination, distraction) repeated-measures ANOVA was conducted on anxiety levels. Results revealed a significant main effect of time, $F(1, 81) = 39.01$, $p < 0.001$, $^2 = 0.33$; a significant main effect of psychological state, $F(1, 81) = 5.87$, $p = 0.02$, $^2 = 0.07$; and a significant time × psychological state interaction, $F(1, 81) = 32.77$, $p < 0.001$, $^2 = 0.29$. Simple effects analysis found that in the rumination state, the main effect of time was not significant, $F(1, 81) = 0.14$, $p = 0.71$; in the distraction state, the main effect of time was significant, $F(1, 81) = 70.79$, $p < 0.001$, $^2 = 0.47$, with post-test anxiety levels significantly lower than pre-test levels. See Figure 4 [Figure 4: see original paper].

Figure 4 [Figure 4: see original paper] Effects of rumination on social anxiety. Note: *** indicates $p < 0.001$

The Role of Negative Self-Beliefs in the Effect of Rumination on Social Anxiety

Change scores were calculated to observe individual state changes under different manipulated psychological states, obtained by subtracting pre-test scores from post-test scores. Correlation analysis of these change scores revealed that changes in rumination were positively correlated with changes in self-beliefs ($r = 0.40$, $p < 0.001$) and social anxiety ($r = 0.58$, $p < 0.001$), and changes in self-beliefs were also positively correlated with changes in social anxiety ($r = 0.43$, $p < 0.001$).

Mediation analysis employed Model 4 in the PROCESS macro for SPSS 22.0

to establish the mediation model. To assess the significance of effects, 5,000 bootstrap resamples were conducted. In this study, using the change score model (Jansen et al., 2013), the experimental manipulation was entered as the independent variable (rumination manipulation coded as 1, control group coded as 0), Δ negative self-beliefs as the mediator variable, and Δ anxiety level as the dependent variable, with standardized data used for mediation analysis. Results showed that rumination had a significant positive effect on changes in negative self-beliefs ($\beta = 0.30$, SE = 0.11, t = 2.81, p = 0.006), and changes in negative self-beliefs had a significant positive effect on changes in anxiety levels ($\beta = 0.30$, SE = 0.09, t = 3.21, p = 0.002). Indirect effect analysis revealed that the effect of rumination on anxiety level changes through changes in negative self-beliefs was significant, with an effect size of 0.09, SE = 0.04, 95% confidence interval [0.016, 0.188]. See Figure 5 [Figure 5: see original paper].

Figure 5 [Figure 5: see original paper] Mediating role of changes in negative self-beliefs in the relationship between rumination and social anxiety. Note: ** indicates $p < 0.01$

Experiment 2

Participants

Sample size was estimated using G*Power 3.1. For the statistical tests employed in this experiment, with a significance level set at $\alpha = 0.01$, desired power of 1 -β = 0.80, and medium effect size of f = 0.25, the required sample size was no fewer than 27. This study recruited 59 university students with no history of mental illness (no history of brain injury, schizophrenia, major depression, anxiety disorders, or insomnia), who were right-handed and had normal or corrected-to-normal vision. One participant failed to complete the questionnaire and withdrew midway. A total of 58 participants completed the first visit. During quality checks, four participants were found to have failed to complete the content as required by the instructions, and these participants were excluded from the second visit list. The remaining 54 participants continued to the second visit, during which two participants withdrew midway, leaving 52 participants who completed the entire experiment. One participant was excluded for failing to follow instructions during the experimental task. Data from a final sample of 51 participants were included in the analyses, comprising 20 males and 31 females with a mean age of 20.14 $\pm$ 1.76 years. All participants received monetary compensation after the experiment. The study was approved by the Ethics Committee of the Faculty of Psychology at Southwest University.

Materials and Procedure

The entire experimental process was conducted in two stages, as shown in Figure 6 [Figure 6: see original paper]. During the first laboratory visit, after learning and mastering the concepts of social anxiety and negative self-beliefs, partici-

pants wrote about social anxiety events they had previously experienced (each description no fewer than 50 words) and wrote down the negative self-beliefs they held about each event. Each participant was required to write about four social anxiety events and generate nine different negative self-beliefs for each event. Seven days after the first visit, participants completed the second visit, during which they performed a series of keyboard response tasks. The materials used in the tasks were derived from the social anxiety memories and negative beliefs generated by participants during the first visit, meaning that the experiment used participant-specific and personalized materials.

Figure 6 [**Figure 6: see original paper**] General procedure of the two experimental visits

The second visit' s experimental procedure included three stages: instruction learning, practice, and testing. Experimental programs and materials were developed and presented using PsychoPy 2023.2.3 (https://www.psychopy.org/).

Instruction Learning Stage: In this stage, participants learned three different instructions: react, observe, and reappraise. For each instruction, participants needed to learn and understand the corresponding coping strategy. The react instruction required participants to focus on the sentence itself, maintain a first-person perspective, and naturally contemplate how these statements held true, especially when experiencing related events. The observe instruction required participants to count the number of Chinese characters in the sentence and the strokes of the third character, engaging only in objective observation of the sentence without deep contemplation or emotional response. The reappraise instruction required participants to actively seek contradictory evidence or alternative perspectives, reinterpret the statement from a positive angle, and change their attitude.

Practice Stage: In this stage, participants became familiar with the general procedure of the formal test and practiced the three instructions. Practice materials were selected from the Self-Beliefs Related to Social Anxiety Scale (SBSA). Subsequently, a 5-point mastery rating was administered; participants scoring 4 or higher proceeded to the formal test stage. Those scoring below 4 needed to relearn the instructions until they basically understood the content and experimental requirements.

Testing Stage: The experiment was conducted using a within-subjects design; detailed procedure and design are shown in Figure 7 [Figure 7: see original paper]. Each participant experienced two different conditions—rumination and distraction—in a counterbalanced order across participants, with a 5-minute rest period between conditions. Under each condition, participants completed three story tasks in the order: autobiographical memory—neutral material—autobiographical memory. Each story task consisted of three components: recall, state induction, and negative self-belief coping. Emotional level changes were recorded after the first two components; for the self-belief sentence presentation stage, emotional changes were recorded after each instruction task. In the re-

call stage, participants recalled the social anxiety event based on their written description, with presentation and recall lasting 30 seconds. In the state induction stage, different textual materials were used to induce participants into the corresponding state depending on the condition. Similar to Experiment 1, the induction materials for rumination and distraction states were adopted from previous research (Chen et al., 2020), with four questions for each psychological state, each presented for 1 minute. These questions were selected from the 45 items originally proposed by Nolen-Hoeksema and Morrow (1991) to induce self-reflection in participants. During the sentence presentation stage, instructions and negative self-beliefs were presented sequentially, requiring participants to adopt different coping strategies toward the presented sentences according to the instructions. Each instruction was presented for 2 seconds, and each negative self-belief for 12 seconds. In the neutral, unrelated imagination story condition, neutral sentences related to the story material were presented.

Figure 7 [**Figure 7: see original paper**] Experimental design procedure for Experiment 2

Results

To reduce the impact of material specificity on experimental results, mean values were calculated during analysis. For example, a participant' s final score for "reacting" to self-beliefs under the rumination condition was the mean of six ratings (three repetitions across two different stories).

Effectiveness of Social Anxiety Emotion Induction

Paired-samples t-tests were used to examine whether participants' negative emotion levels differed after reading and recalling social anxiety events versus neutral materials. Results showed significant differences in negative emotion across conditions, $t(50) = 14.32$, $p < 0.001$. Participants' negative emotions when recalling social anxiety events ($M = 3.28$) were significantly higher than when reading neutral materials ($M = 2.16$), with a mean difference of 1.12 ($SD = 0.56$), indicating that recalling social anxiety events effectively induced corresponding emotions.

Effects of Different Psychological States and Materials on Social Anxiety Emotion

A 2 (psychological state: rumination, distraction) × 2 (material: autobiographical memory, neutral story) repeated-measures ANOVA was conducted on participants' negative emotion levels. Results revealed a significant main effect of psychological state, $F(1, 50) = 74.80$, $p < 0.001$, $^2 = 0.60$, with negative emotion levels significantly higher in the rumination state than in the distraction state; a significant main effect of material, $F(1, 50) = 7.32$, $p = 0.009$, $^2 = 0.13$, with negative emotion levels significantly higher after reading autobiographical memories than after reading neutral stories; and a significant psychological state

× material interaction, F(1, 50) = 5.59, p = 0.022, ^{2} = 0.10. Simple effects analysis found that when the material was social anxiety autobiographical memory, the main effect of psychological state was significant, F(1, 50) = 9.31, p = 0.004, ^{2} = 0.16, with negative emotion levels significantly higher in the rumination state than in the distraction state; when the material was neutral stories, the main effect of psychological state was not significant, F(1, 50) = 0.26, p = 0.61. See Figure 8 [Figure 8: see original paper].

Figure 8 [Figure 8: see original paper] Effects of different psychological states and materials on social anxiety emotion. Note: ** indicates p < 0.01, *** indicates p < 0.001

Effects of Coping Strategies for Negative Self-Beliefs on Social Anxiety Emotion Under Different Psychological States

A 2 (psychological state: rumination, distraction) × 4 (coping strategy: react, observe, reappraise, and neutral control) repeated-measures ANOVA was conducted on negative emotion levels. Results revealed a non-significant main effect of psychological state, F(1, 50) = 2.77, p = 0.102; a significant main effect of coping strategy, F(3, 150) = 120.89, p < 0.001, ^{2} = 0.71, with post-hoc comparisons showing significant differences between all pairs, and the resulting negative emotion levels were: react > observe > reappraise > neutral control; and a non-significant psychological state × coping strategy interaction, F(3, 150) = 0.32, p = 0.81. See Figure 9 [Figure 9: see original paper].

Figure 9 [Figure 9: see original paper] Effects of coping strategies for negative self-beliefs on social anxiety emotion under different psychological states. Note: ** indicates p < 0.01, *** indicates p < 0.001

The average emotion level score after using coping strategies for negative self-beliefs was subtracted from the baseline score when negative self-beliefs were not presented (i.e., the emotion level after completing the state manipulation task) to obtain change scores reflecting the impact of different coping strategies on emotion levels under different psychological states. A 2 (psychological state: rumination, distraction) × 4 (coping strategy: react, observe, reappraise, neutral control) repeated-measures ANOVA was conducted on these emotion change scores. Results revealed a significant main effect of psychological state, F(1, 50) = 85.32, p < 0.001, ^{2} = 0.63, with emotion change scores after coping with negative self-beliefs significantly higher in the distraction state than in the rumination state; a significant main effect of coping strategy, F(3, 150) = 78.06, p < 0.001, ^{2} = 0.83, with post-hoc comparisons showing significant differences between all pairs, and negative emotion change scores across different coping strategies were: react > observe > reappraise > neutral control; and a non-significant psychological state × coping strategy interaction, F(3, 150) = 1.60, p = 0.20. See Figure 10 [Figure 10: see original paper].

Figure 10 [Figure 10: see original paper] Emotion changes using different coping strategies for negative self-beliefs under different psychological states

General Discussion

This study examined the mechanisms through which rumination influences social anxiety and revealed the important role played by negative self-beliefs in this process. Experiment 1, through rumination state induction, identified positive correlations among rumination, negative self-beliefs, and social anxiety, and validated the hypothesis that rumination affects social anxiety through negative self-beliefs. Experiment 2, using more ecologically valid experimental materials and paradigms, revealed that intervening in negative self-beliefs can effectively alleviate social anxiety, confirming their important role in maintaining social anxiety. Overall, this study extends the cognitive model of social anxiety and holds significant theoretical and practical implications for understanding the factors underlying the onset and maintenance of social anxiety and for developing more effective intervention approaches.

Mechanisms of Rumination and Negative Self-Beliefs in Social Anxiety

Experiment 1 measured participants' rumination, negative self-beliefs, and social anxiety levels twice and calculated change scores on these measures during the experiment by comparing post-test and pre-test scores. Group-based difference analysis results showed that participants' anxiety levels appeared to decrease slightly after rumination, but this change was not statistically significant, whereas the control group showed a very significant decrease in anxiety levels. Similarly, negative self-beliefs in the rumination group decreased, but the magnitude of decrease was far smaller than in the control group. Overall correlation analysis results showed significant positive correlations among these change scores. This correlation indicates that when individuals' rumination states change, their negative self-beliefs and social anxiety levels change accordingly—more rumination predicts enhanced negative self-beliefs and intensified social anxiety, and vice versa. These results align with cognitive theories of social anxiety, which collectively point to the role of rumination in deepening individuals' negative cognitions and maintaining negative emotions (Gkika et al., 2018; Watkins & Roberts, 2020; Zetsche et al., 2018).

This finding is also consistent with previous research: numerous early studies have revealed positive correlations between rumination and social anxiety (Jose et al., 2012; Kocovski & Rector, 2007; Lundh & Sperling, 2002), both in individuals with social anxiety disorder (Chen et al., 2013) and non-clinical populations (Abdollahi, 2019). Furthermore, many studies have noted that rumination is highly self-focused, and this self-centered thinking contributes to increased negative emotions and cognitive biases (Moberly & Watkins, 2008), implying a positive correlation between rumination and negative self-beliefs. One study also found that rumination levels could predict the strength of social anxiety-related negative self-beliefs at future time points (Wong & Moulds, 2012). As a core factor in social anxiety, the positive correlation between negative self-

beliefs and social anxiety has been demonstrated in previous research (Dryman & Heimberg, 2018; Hoffmann et al., 2024). Therefore, the results of this experiment support the cognitive theory of social anxiety regarding the relationships among these three variables, highlighting the important role of rumination and negative self-beliefs in maintaining social anxiety.

The mediation analysis results from Experiment 1 showed that changes in negative self-beliefs mediated the effect of rumination manipulation on changes in social anxiety. This indicates that the rumination manipulation (i.e., the experimental condition prompting participants to engage in rumination) not only directly affected changes in social anxiety but also indirectly influenced social anxiety by altering the degree of negative self-beliefs. Specifically, this means that during rumination, participants' negative self-beliefs showed an increasing trend over time, which in turn led to elevated social anxiety levels. This finding deepens our understanding of the role of rumination in the onset and maintenance of social anxiety and also confirms the hypothesis in social anxiety theory that negative self-beliefs serve as a bridge between the two (Clark & Wells, 1995; Wong et al., 2021).

Cognitive theories of social anxiety emphasize the important role of cognitive factors in maintaining social anxiety. These theories posit that social anxiety stems from the gap between individuals' perceived social standards and their perceived social competence, a gap often resulting from underestimation of personal abilities and excessively high demands for social standards (Mason et al., 2019). Given the presence of such maladaptive cognitions, individuals with social anxiety often hold negative self-beliefs that bring about worry, anxiety, and other negative emotions (Boden et al., 2012). Additionally, when facing threatening social situations, individuals shift their attention inward, engaging in detailed self-examination and monitoring (Mellings & Alden, 2000). In this highly self-focused state, individuals typically experience spontaneous, repetitive, negative self-referential processing that reinforces established negative self-biases and perpetuates distress (Rimes & Watkins, 2005; Watkins & Roberts, 2020).

A key characteristic of rumination is its amplification of maladaptive cognitions, conceptualized as processing environmental information and thinking about personal thoughts, including rigid, counterfactual, and unrealistic beliefs, particularly about the self, world, and future (Ciesla & Roberts, 2007). As cognitive theories suggest, this indicates that the rumination process helps individuals consolidate and deepen negative cognitive biases about their social performance. During this thought process, individuals' negative self-beliefs are reinforced, negative emotions are maintained or even intensified, ultimately leading to social anxiety. Therefore, the mediation analysis results demonstrate that rumination can cause individuals to ignore external information and immerse themselves in negative emotions triggered by real or imagined failures; simultaneously, it can lead individuals to deepen negative cognitive biases and negative beliefs through self-directed repetitive thinking, thereby affecting social anxiety levels. That is, rumination can directly influence emotions and also produce sustained emotional

effects by altering cognitive factors. This finding validates and supplements the assumptions of cognitive models while also providing a new perspective for social anxiety interventions, suggesting that focusing on and adjusting negative self-beliefs may serve as a key strategy for breaking the cycle between rumination and social anxiety.

Improving Negative Self-Beliefs to Alleviate Rumination-Triggered Social Anxiety

Building upon Experiment 1, Experiment 2 collected and used participants' personally experienced social anxiety events and real negative self-beliefs as experimental materials, aiming to more authentically reflect how people ruminate on social anxiety events and hold negative beliefs in reality.

Comparisons of participants' negative emotion levels after presenting negative self-beliefs indicated a significant main effect of coping strategy on social anxiety, with negative emotion levels significantly lower when using reappraisal compared to direct reaction and objective observation. As an emotion regulation strategy, cognitive reappraisal is believed to play a role in processing negative self-biases and negative emotions (Troy et al., 2018). This suggests that compared to direct reaction and objective observation, the cognitive reappraisal strategy can prompt individuals to seek evidence and explanations from a positive perspective, thereby reducing the impact of negative self-beliefs on emotions (Riepenhausen et al., 2022).

Additionally, the experiment found that although rumination after reading different materials increased individuals' negative emotions, reading autobiographical memories produced a significantly stronger effect. This effect has been repeatedly reported in previous research, showing that self-focused rumination can cause individuals to distort memories, form negative judgments about themselves, amplify the impact of mistakes, generate more negative emotions, hold pessimistic attitudes about the future, and impair problem-solving abilities (Lyubomirsky & Nolen-Hoeksema, 1995; Mor & Winquist, 2002; Rimes & Watkins, 2005). It is precisely because of these cognitive processes and effects that self-focused rumination is closely linked to social anxiety (Mellings & Alden, 2000; Norton & Abbott, 2016). To counteract the negative effects of rumination, some researchers have proposed using distraction strategies to shift attention to external objects and avoid excessive self-centered thinking (McGreevy et al., 2015).

However, the analysis results indicated that aside from the significant main effect of coping strategy, both the main effect of psychological state and the interaction were non-significant. This suggests that whether participants engaged in rumination or distraction imagery, after coping with negative self-beliefs, the difference in negative emotion levels between the two states was not significant. Further analysis of emotion change scores revealed a significant main effect of psychological state, with negative emotion increase significantly higher in the

distraction state than in the rumination state. Comparing the results of these two analyses suggests that although distraction tasks can reduce social anxiety, this effect is temporary. Once individuals need to confront their negative thoughts again, negative emotions rebound immediately, potentially rising to levels equivalent to those after rumination. This seems to imply that if individuals do not eliminate their negative cognitions but only temporarily disengage from these thoughts, although negative emotions may be somewhat alleviated, this remains a "symptomatic rather than fundamental" approach.

Previously, to address controversies regarding the effectiveness of distraction strategies, one study used a person-oriented approach to analyze the relationship between distraction strategies and emotion regulation, ultimately finding that the effectiveness of distraction depends on whether it is combined with an accepting attitude or with avoidance strategies, thereby emphasizing the role of cognition (Wolgast & Lundh, 2017). This may suggest that using distraction strategies as an intervention to avoid rumination is not an optimal solution for treating social anxiety, as it does not demonstrate ideal sustained effects in alleviating social anxiety. Conversely, intervening in negative self-beliefs can significantly reduce negative emotions triggered by social anxiety autobiographical memories and is less affected by prior psychological states. This result supports the fundamental principles of Cognitive Behavioral Therapy (CBT), which improves individuals' emotional states and mental health by changing cognitions and behaviors (Van Dis et al., 2020), and also reaffirms the importance of cognitive factors emphasized in social anxiety theory. Overall, the experimental results indicate that intervening in individuals' negative self-beliefs through cognitive reappraisal can reduce social anxiety. Moreover, using reappraisal as a coping strategy rather than adopting distraction to escape rumination—that is, changing cognitive factors—represents a more effective approach to resolving social anxiety.

Limitations and Future Directions

This study has several limitations. First, this study only included observations of key variables and established relationships among them based on these observations, thereby overlooking the influence of other environmental factors to some extent. Future research should consider the limitations of current studies and attempt to incorporate more variables and environmental factors using more comprehensive and integrated research methods to enhance the complexity, accuracy, and generalizability of findings. Second, due to the current lack of a reliable tool specifically designed to measure state changes in social anxiety, this study adopted measurement methods from previous research, which may have limitations in capturing precise changes in social anxiety. Future research should 致力于 developing more precise and targeted measurement tools to more effectively assess social anxiety changes in specific situations. Additionally, due to constraints in current experimental conditions, this study employed a short-term intervention strategy. Future research could attempt to design and use

more sophisticated and targeted intervention methods to more comprehensively observe and evaluate intervention effects through long-term implementation. Finally, this study has limitations in participant selection regarding geographical and cultural backgrounds. Future research should strive to expand the participant pool and consider cultural and regional factors in the design to obtain more generalizable and stable results.

Conclusion

This study explored the important role of negative self-beliefs in the process of rumination affecting social anxiety and examined the effectiveness of improving negative self-beliefs through cognitive reappraisal to alleviate social anxiety. The main conclusions are as follows: (1) Rumination, social anxiety, and negative self-beliefs are significantly positively correlated; (2) Rumination affects social anxiety by maintaining negative self-beliefs; (3) Using cognitive reappraisal to cope with negative self-beliefs can alleviate social anxiety, and compared to distraction strategies, intervening in negative self-beliefs is a more effective means of reducing social anxiety. These conclusions extend the cognitive model of social anxiety and provide theoretical foundations for understanding the relationships among these three variables and developing effective social anxiety intervention programs.

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Supplementary Materials

Supplementary Material 1: Descriptive Statistics of Participants' Scores Under Different Conditions in Experiments 1 and 2

Supplementary Table 1 Scores of the Experimental and Control Groups on Rumination, Negative Self-Beliefs, and Social Anxiety in Experiment 1 (M ± SD)

Group	State Rumination	Negative Self-Beliefs	Social Anxiety Level
Experimental Group (N = 42)	356.19 ± 175.78	62.26 ± 22.70	48.00 ± 9.13
Control Group (N = 41)	397.17 ± 174.18	56.27 ± 22.15	48.29 ± 11.21

Supplementary Table 2 Negative Emotion Levels of Participants Under Different Experimental Materials and Psychological States in Experiment 2 (M ± SD)

Psychological State	Autobiographical Memory	Neutral Story
Rumination	2.95 ± 1.00	2.51 ± 0.99
Distraction	1.50 ± 0.55	1.45 ± 0.78

Supplementary Table 3 Negative Emotion Levels of Participants After Using Different Coping Strategies for Negative Self-Beliefs Under Different Conditions in Experiment 2 (M ± SD)

Coping Strategy	Rumination State	Distraction State
React	3.10 ± 0.78	3.19 ± 0.72
Observe	2.03 ± 0.79	2.13 ± 0.80
Reappraise	1.81 ± 0.58	1.89 ± 0.57
Neutral Control	1.28 ± 0.42	1.29 ± 0.42

Supplementary Material 2: Relationships Among Three Different Types of Negative Self-Beliefs, Rumination, and Social Anxiety

1. Randomization Check

Independent-samples t-tests were conducted on the three different types of self-belief levels between the experimental and control groups at the time of group assignment (i.e., pre-test). Results showed no significant differences in these measures across groups, confirming successful randomization and no significant baseline differences between the two groups. Specific results are presented in the table below.

Supplementary Table 4 Analysis of Differences in Three Types of Self-Beliefs Across Groups

Group	High Social Standards Beliefs	Unconditional Beliefs	Conditional Beliefs
Experimental Group (N = 42)	17.48 ± 6.84	13.83 ± 6.45	30.95 ± 12.85
Control Group (N = 41)	16.49 ± 6.49	12.24 ± 5.95	27.44 ± 12.99

2. Effects of Rumination on High Social Standards, Unconditional, and Conditional Beliefs

A 2 (time: pre-test, post-test) × 2 (psychological state: rumination, distraction) repeated-measures ANOVA was conducted on participants' high social standards belief levels. Results revealed a significant main effect of time, $F(1, 81) = 12.92$, $p = 0.001$, $^2 = 0.14$; a non-significant main effect of psychological state, $F(1, 81) = 1.23$, $p = 0.271$; and a marginally significant time × psychological state interaction, $F(1, 81) = 3.74$, $p = 0.057$, $^2 = 0.04$. A 2 (time: pre-test, post-test)

× 2 (psychological state: rumination, distraction) repeated-measures ANOVA was conducted on participants' unconditional belief levels. Results revealed a significant main effect of time, $F(1, 81) = 11.95$, $p = 0.001$, $^2 = 0.13$; a non-significant main effect of psychological state, $F(1, 81) = 2.86$, $p = 0.095$; and a non-significant time × psychological state interaction, $F(1, 81) = 2.94$, $p = 0.09$. A 2 (time: pre-test, post-test) × 2 (psychological state: rumination, distraction) repeated-measures ANOVA was conducted on participants' conditional belief levels. Results revealed a significant main effect of time, $F(1, 81) = 38.82$, $p < 0.001$, $^2 = 0.32$; a significant main effect of psychological state, $F(1, 81) = 4.36$, $p = 0.04$, $^2 = 0.05$; and a significant time × psychological state interaction, $F(1, 81) = 5.89$, $p = 0.017$, $^2 = 0.07$. Simple effects analysis found that at pre-test, the main effect of psychological state was not significant, $F(1, 81) = 1.53$, $p = 0.22$; at post-test, the main effect of psychological state was significant, $F(1, 81) = 8.50$, $p = 0.005$, $^2 = 0.10$, with conditional beliefs in the distraction state significantly lower than in the rumination state.

Supplementary Figure 1 Effects of rumination on three different types of negative self-beliefs

The data analysis results showed that the main effect of time was significant across all three types of self-beliefs, indicating that all types of self-beliefs showed some degree of extinction over time in this study. In the analysis of conditional belief scores, the main effect of psychological state was significant, suggesting that rumination and distraction states had different effects on conditional beliefs, whereas this effect was not significant for the other two belief types, indicating that conditional beliefs are relatively more susceptible to rumination. Additionally, the time × psychological state interaction was significant for conditional beliefs; although similarly significant results were not obtained for the other two types, they showed the same changing trends. Overall, the changing trends of the three belief types were basically consistent in this study.

3. The Role of Three Types of Negative Self-Beliefs in the Effect of Rumination on Social Anxiety

Change scores for the three types of negative self-beliefs before and after the state induction task were calculated by subtracting pre-test scores from post-test scores. Correlation analysis of change scores in rumination, social anxiety, and the three types of self-beliefs revealed that unconditional beliefs ($r = 0.45$) and conditional beliefs ($r = 0.33$) were significantly correlated with change scores in social anxiety, while high social standards beliefs were not; high social standards beliefs ($r = 0.30$), unconditional beliefs ($r = 0.32$), and conditional beliefs ($r = 0.31$) were all significantly correlated with change scores in rumination. Mediation analysis was conducted on unconditional and conditional beliefs using the same approach. Results showed that conditional beliefs mediated the effect of rumination on social anxiety, while the mediation model for unconditional beliefs was not significant.

Supplementary Figure 2 Mediation tests for different types of negative self-

beliefs in the relationship between rumination and social anxiety

Supplementary Material 3: Effectiveness Analysis of Using Cognitive Reappraisal as a Coping Strategy

A 2 (time: pre-test, post-test) × 2 (psychological state: rumination, distraction) repeated-measures ANOVA was conducted on negative emotion levels under the reappraisal strategy. Results revealed: a significant main effect of time, $F(1, 50) = 17.67$, $p < 0.001$, $^{2} = 0.26$, indicating that the reappraisal strategy significantly reduced negative emotions between pre-test and post-test regardless of whether participants were in the rumination or distraction state, demonstrating that reappraisal is effective overall in alleviating social anxiety; a significant main effect of psychological state, $F(1, 50) = 75.41$, $p < 0.001$, $^{2} = 0.60$, meaning there were significant differences between rumination and distraction states, with participants experiencing the rumination state showing higher negative emotion levels; and a significant time × psychological state interaction, $F(1, 50) = 83.28$, $p < 0.001$, $^{2} = 0.63$, with significant differences in negative emotions between the two states at pre-test but not at post-test, indicating that changes in negative emotions over time differed across psychological states.

Supplementary Figure 3 Effects of using "reappraisal"on social anxiety under different psychological states (*** indicates $p < 0.001$)

Note: Figure translations are in progress. See original paper for figures.