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Biases in Interpretation and Memory in Generalized Social Phobia

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Two experiments examined the link between interpretation and memory in individuals diagnosed with Generalized Social Phobia (GSP). In Experiment 1, GSP and control participants generated continuations for nonsocial and ambiguous social scenarios. GSP participants produced more socially anxious and negative continuations for the social scenarios than did the controls. On the subsequent test of recalling the social scenarios, intrusion errors that shared meaning with the original continuations were made more frequently by the GSP group, producing false recall with emotionally negative features. To examine whether nonanxious individuals would also produce such errors if given emotional interpretations, in Experiment 2 the authors asked university students to read the scenarios plus endings produced by GSP participants in Experiment 1. The students either constructed vivid mental images of themselves as the main characters or thought about whether the endings provided closure. Low-anxious students in the closure condition produced fewer ending-based intrusions in recalling the social scenarios than did students in the other 3 conditions. Results illustrate the importance of examining the nature of source-monitoring errors in investigations of memory biases in social anxiety.

Keywords: social anxiety, social phobia, memory, interpretation

Recent models of cognitive processing in social phobia serve as useful frameworks for understanding how socially anxious individuals interpret and remember social events (Clark & Wells, 1995; Rapee & Heimberg, 1997). The frameworks predict that when individuals with social anxiety are confronted with new social situations, they tend to interpret them in a threatening manner because of established negative assumptions and experience a variety of negative consequences such as increases in anxiety and physical symptoms. The frameworks also suggest that socially anxious individuals selectively remember and brood about negative self-relevant aspects of social events. Postevent rumination presumably contributes to an increase in socially anxious individuals' anticipatory anxiety and strengthens avoidance strategies for future social interactions. Although there is considerable evidence for biased interpretations in social anxiety, evidence supporting the sort of memory bias implied by postevent rumination is scant.

Researchers have used a variety of paradigms to examine interpretation biases in socially anxious individuals. The overwhelming majority of studies have found negative interpretation biases for social scenarios both in individuals with high levels of social anxiety (e.g., Amir, Beard, & Bower, 2005; Brendle & Wenzel, 2004; Mellings & Alden, 2000; Voncken, Bogels, & de Vries, 2003; Wenzel, Finstrom, Jordan, & Brendle, 2005) and in clinically diagnosed samples (e.g., Amir, Foa, & Coles, 1998; Stopa & Clark, 2000). Even when evidence for a negative bias was not obtained, investigators have found that individuals with high levels of social anxiety (e.g., Brendle & Wenzel, 2004; Constans, Penn, Ihen, & Hope, 1999; Hirsch & Mathews, 1997) and individuals who are diagnosed with social phobia (Hirsch & Mathews, 2000) lack the positive interpretation bias that is typically exhibited by nonanxious control participants. Thus, it is clear that socially anxious individuals interpret ambiguous social material in a more negative or less positive manner than do their nonanxious counterparts.

In contrast to the literature on interpretive biases, however, most studies have not found evidence of memory bias either in highly anxious participants (e.g., Brendle & Wenzel, 2004; Constans et al., 1999; Sanz, 1996; Wenzel et al., 2005) or in clinical samples (e.g., Amir, Coles, Brigidi, & Foa, 2001; Becker, Roth, Andrich, & Margraf, 1999; Cloitre, Cancienne, Heimberg, Holt, & Liebowitz, 1995; Rapee, McCallum, Melville, Ravenscroft, & Rodney, 1994; Rinck & Becker, 2005). Two exceptions to this pattern were obtained in investigations of implicit memory, in which deliberate focus on the past was not involved (Amir, Foa, & Coles, 2000; Lundh & Ost, 1997).

Three additional exceptions to the usual lack of memory bias in social phobia were found in studies using explicit memory tests, and the results of these investigations offer clues concerning the conditions that contribute to the bias. First, Mansell and Clark (1999) threatened high and low socially anxious participants with the prospect of giving an impromptu speech before they completed a memory task. These socially anxious participants exhibited reduced recall of positive public self-referent words. Similarly, the procedure used by Mellings and Alden (2000) included a social

interaction with a confederate, followed by a request to recall the interaction on the next day. Socially anxious participants who were asked to ruminate and to focus on themselves before the recall task recalled fewer partner-related and more negative self-related aspects. These findings indicate that the induction of self-focus may be important in generating a memory bias. Finally, using a face-recognition task, Lundh and Ost (1996) found that socially phobic participants remembered more faces that they had previously judged to be critical (instead of accepting), whereas the opposite was found for the control participants. This finding suggests that it is important to consider participants' initial interpretations of the social stimuli while examining memory biases.

The present study was designed to investigate more systematically the connection between interpretation of social events and memory biases in social phobia. A long tradition of research on constructive and reconstructive memory, beginning with Bartlett (1932), has demonstrated connections between the ways in which social events are understood and how they are subsequently remembered. Further, research on reality monitoring (Johnson & Raye, 1981) has demonstrated that memory errors can be caused by failures to distinguish between externally and internally generated events at the time of remembering. If socially anxious people experience reality-monitoring confusions, they would tend to reconstruct their memory for (externally generated) social situations partly on the basis of their (internally generated) interpretations. In short, memory biases should become evident when both initial interpretations and monitoring errors are taken into account. We propose that a lack of attention to possible confusions regarding the source of memories is an important reason why most studies have not found memory biases to be associated with social anxiety.

To measure interpretations, we asked participants to provide continuations for ambiguous social scenarios (interspersed with nonambiguous nonsocial scenarios) and, subsequently, to remember both the scenarios and their continuations. To encourage socially anxious thoughts, we included two additional features in the design prior to the presentation of scenarios. First, we staged a conversation between the participants and a confederate with the intention of inducing self-focus and active social anxiety in the socially anxious participants (see Mansell & Clark, 1999; Mellings & Alden, 2000). Second, we varied the degree of self-focus following that conversation by using a thought-induction task: rumination or distraction (a modification of tasks used by Nolen-Hoeksema & Morrow, 1993). We predicted that the rumination condition would produce clearer evidence of interpretation bias in social anxiety.

On the basis of previous evidence for interpretation bias in social anxiety, we expected that participants diagnosed with Generalized Social Phobia (GSP) would generate more socially anxious continuations to the ambiguous social scenarios than would control participants. Then, to investigate memory bias, we examined recalled scenarios for the possibility of threat-related bias in the GSP group. In place of a more traditional emphasis on conditions for accurate recall, our interest centered on the nature of memory errors or intrusions. We predicted that GSP participants would produce more intrusions that reflect the nature of their socially anxious continuations, blurring the distinction between memory for the scenario and memory for their own interpretations. In real-world settings, these intrusions constitute errors in reality monitoring. Because we presented verbal descriptions in place of actual situations, however, we conceptualize errors in distinguish-

ing between memory for those descriptions and participants' subsequent interpretations as source-monitoring errors.

Experiment 1

Method

Participants and Design

Potential participants responded to Internet advertisements posted on a highly frequented website for the San Francisco Bay area concerning paid research opportunities at Stanford University. Readers were asked to respond if they avoided social situations and if they often worried about being embarrassed or humiliated in public (or if they never had these experiences). Respondents were interviewed over the telephone as an initial screening procedure. Trained research assistants administered the telephone interview, which took approximately 30 min and included portions of the Structured Clinical Interview (SCID; First, Spitzer, Gibbon, & Williams, 1997) for the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV;* American Psychiatric Association, 1994). Individuals who reported experiencing severe head trauma, neurological disorders such as Parkinson's disease, learning disabilities, any psychotic symptoms during their lifetime, or alcohol or substance abuse or dependence within the last 6 months were excluded from further participation. Individuals who were likely to meet criteria for GSP or who appeared to be never-disordered were invited to come to the laboratory for a more extensive interview.

Potential participants were interviewed in person using the SCID and were assigned to the GSP group if they met *DSM–IV* criteria for a diagnosis of GSP. Because cognitive discrepancies in the social anxiety literature might in part be associated with comorbidity, individuals who met GSP criteria were excluded if they also met *DSM–IV* criteria for current Major Depressive Disorder or Bipolar Disorder. (Axis II disorders were not assessed.) As a result, Axis I comorbidity in our final sample was low. Of the 32 GSP participants, 1 was diagnosed with obsessive-compulsive disorder, 2 with dysthymia, 1 with agoraphobia without panic disorder, and 1 with generalized anxiety disorder. To be eligible for inclusion in the control group, the interviewer confirmed that the individual had no lifetime history of Axis I disorders. Individuals who met these inclusion criteria were scheduled for a second session during the following week. The final sample consisted of 64 participants (20 women and 12 men in both the GSP group and control group).

Materials

Thought-induction materials. The rumination and distraction materials from Nolen-Hoeksema and Morrow (1993) were modified and used to induce rumination or distraction following the participant's interaction with the confederate. We selected 14 phrases from each set for the participants to "concentrate on and think about" during an 8-min period. The phrases selected for rumination typified self-evaluative thought processes of socially anxious individuals following a social interaction (e.g., *why you react the way you do*, *what people notice about your personality*, *how similar/different you are relative to other people*). In contrast, individuals in the distraction induction were asked to concentrate

on external images or objects that were not related to the self (e.g., *a boat slowly crossing the Atlantic*, *the shape of a large black umbrella*, *the structure of a high-rise building*).

Scenarios. Ten social and 10 nonsocial scenarios were created; some were adapted from Mathews and Mackintosh (2000), and others were developed by Faith Brozovich. Each scenario ended abruptly and thereby provided the occasion for a participant-created ending. The social scenarios were ambiguous in terms of possible threatening or nonthreatening interpretations, which we purported to infer from the participants' endings. One such scenario was "The Wedding Reception" (from Mathews & Mackintosh, 2000, p.604):

> Your friend asks you to give a speech at her wedding reception. You prepare some remarks and when the time comes, get to your feet. As you speak, some people in the audience start to laugh.

We used nonsocial scenarios in order to make our interests less obvious. One of our newly developed nonsocial scenarios was "Your New CD":

> You heard a song on the radio and went out to buy the CD right away. When you return home you listen to it on your stereo and turn the volume up. After a few songs, you regret the purchase.

Each scenario was composed of three sentences; together, the second and third sentences expressed a total of five idea units. For example, "The Wedding Reception" included the following: *prepare remarks, it is time, get to your feet, you speak, people laugh.* "The New CD" included the following: *return home, listen to the CD, turn up the volume, after a few songs, regret purchase.* All computer tasks were implemented with E-Prime software (Version 1.1.4.1, Psychology Software Tools, Inc.).

Questionnaires. Participants completed a "personal-characteristics" questionnaire at four time points throughout the session; they rated their current levels of anxiety and nervousness on Likert scales (e.g., 1 = *not anxious*, 9 = *very anxious*). We disguised our focus on anxiety by including filler items (e.g., *tired*, *curious*, and *dreamy*). Participants also completed a series of questionnaires often used in cognitive studies of social anxiety: the Post-Event Processing Questionnaire (PEP; Rachman, Gruter-Andrew, & Shafran, 2000) that assesses how much and how often participants engaged in rumination following a social event in the last few months; the Fear of Negative Evaluation Scale (FNE; Watson & Friend, 1969), a 30-item true/false questionnaire that asks participants to indicate how often they negatively evaluate themselves or fear that others are doing so in social situations; the Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969), a 28-item true/false questionnaire that asks participants to evaluate their feelings following typical social situations based on their personal experiences; and the Social Phobia Anxiety Inventory (SPAI; Turner, Beidel, Dancu, & Stanley, 1989), a frequently used measure assessing severity of social anxiety symptoms.

Procedure

Upon arrival, each participant was taken to a waiting room, having been told that the session was delayed due to a previous participant's late arrival. The first personal-characteristics questionnaire was administered; shortly thereafter, an opposite-sex confederate entered the room and began a 10-min conversation with the participant. The confederate discussed a scripted list of topics and questions (e.g., the confederate's job and restaurants and museums in the Bay area, because the confederate had supposedly just moved there). Following the conversation, the experimenter took the participant to the computer room. The experimenter described the session as a series of short experiments that focused on concentration, memory, and imagination. Participants then completed the second personal-characteristics questionnaire. For all of the computer tasks, the experimenter read aloud the instructions (which were also presented on the computer) and queried to ensure that the participant understood them. All materials were presented in black font on a white background.

Thought inductions. In the first task, participants received either the rumination or distraction induction and were told that this task concerned their ability to concentrate. They were instructed to use their imagination and concentration to focus on the idea represented by each phrase. The experimenter then left the room, and each of the 14 phrases appeared for 30 s, followed by a Likert scale ranging from 1–7; the participants used the keyboard to rate their level of concentration. The program then advanced to the next phrase. The induction task took approximately 8 min to complete, after which participants filled out the third personal-characteristics questionnaire.

Scenarios. Next, participants were presented with the scenarios, one at a time, on the computer screen. The title appeared on the first line, with the text immediately below. Participants were asked to imagine themselves as the central character of each scenario and to generate at least one additional sentence to finish each story. Once they had silently read the scenario on the screen, they said aloud the first ending to the story that came to mind, and these responses—termed *continuations*—were recorded on audiotape. Participants completed three practice trials with nonsocial scenarios while the experimenter was in the room to ensure that they understood the procedure. After the experimenter left the room, the 20 test scenarios were presented in random order and self-paced. A 3-min digit/symbol-substitution task from the Wechsler Adult Intelligence Scale—Revised (WAIS-R; Wechsler, 1981) separated the interpretation task from the memory task.

Memory task. We cued recall of each scenario by presenting its first sentence, and then we asked participants to recall aloud the remaining two sentences in the scenario. After the participants had finished recalling the scenario, they pressed the space bar, advancing the program to the next screen, which prompted them to recall their own ending. They said the words "my ending" aloud before reporting recall of the continuation. Once again, participants practiced the procedure with the three nonsocial practice scenarios while the experimenter was still in the room and then performed the randomized test trials alone at their own pace.

Questionnaires. At the end of the session, participants completed a packet of questionnaires including the final personal-characteristics questionnaire, PEP, SADS, FNE, and SPAI, in that order. They received a partial debriefing if they asked about the confederate interaction. Otherwise, they received a full debriefing 1 week later during a follow-up phone call. The session lasted between 60 and 90 min, and participants were paid $25 per hour.

Coding and Scoring Procedures

Three raters coded the participants' continuations of the scenarios as belonging to one of five categories: socially anxious, anxious, other negative, neutral, or positive. The socially anxious category was used when the participant continued the scenario by expressing fear of embarrassment, fear of being observed or judged by others, or discomfort involving other people in the situation (e.g., *I feel so embarrassed at this party*). This category also included the experience of physical symptoms that were related to the social situation (e.g., *I can feel my face turning red while I'm talking*). The anxious category was used if the person expressed anxiety that was not particularly related to the social situation (e.g., *I'm having problems breathing*). The "otherwise negative" category was used for continuations that reflected negative thoughts and feelings unrelated to anxiety (e.g., *I feel so bad—this happens all the time*). Continuations were rated as neutral if they did not reflect emotion or symptoms of disorders (e.g., *people are always late*). Finally, the positive category was used for continuations that reflected some positive emotion (e.g., *I am so glad because I have time to read my book now*). Measures of agreement were computed for each scenario and each pair of raters (average $\kappa = .69$).

A recalled social scenario was scored as containing at least one intrusion if the protocol contained any new term that had not been presented originally; interclass correlation coefficient (ICC) = .83. The raters noted whether the intrusion reflected the meaning of the initial continuation; if it did, they classified the intrusion as belonging to that same category of emotion. Table 1 contains examples of scenarios recalled with intrusions that reflect the meaning of the corresponding continuation. Because inspection of the intrusion data revealed problems with the data from one rater, analyses of recall intrusions are based on data averaged across the other two raters ($\kappa = .64$).

Results and Discussion

Table 2 presents information about the demographic and clinical characteristics of participants in the GSP and control groups. Participants in the two groups did not differ significantly on any of the demographic variables, $p > .15$. As expected given our selection criteria, the two groups differed on all of the measures of anxiety, $p < .001$.

For measures of interpretation and recall bias, separate analyses of variance (ANOVAs) were conducted on the percentages of the 10 social scenarios within each emotion category, due to lack of independence across categories. Because raters rarely used the "other anxious" category (see Table 3), data from that category were not analyzed. Each analysis included between-subjects factors for group (GSP vs. control) and thought induction (rumination vs. distraction). The significance level was set at .05. Unreported effects were nonsignificant, $p > .15$. Effects associated with thought induction were nonsignificant (and discussed more fully in a subsequent section).

Table 1
Examples of Social Scenarios, Continuations, and Recall

| Scenario | GSP | | CONTROL | |
	Continuation	Recalled scenario	Continuation	Recalled scenario
You are invited to attend a social at a local club, whose members you don't know very well. As you approach the door you hear loud conversation. When you enter the room, it stops.	I guess I look pretty weird in the club. I'm not the typical person you'd find at a club. (socially anxious)	When I come in they all stop and stare at me. (socially anxious intrusion)	I nod as a form of greeting, sit down quietly and wait for the conversation to begin again. (neutral)	While approaching the door, I hear loud conversation. When I enter the room, however, the conversation ends. (no intrusion)
Your friend asks you to give a speech at her wedding reception. You prepare some remarks and when the time comes, get to your feet. As you speak, some people in the audience start to laugh.	I'll wrap up my speech as quickly as I can, as I fear that they are laughing at me. (socially anxious)	You spend many hours rehearsing what you need to say, and when the time comes you get up and make your speech. As you start speaking you realize that people are laughing at you. (socially anxious intrusion)	You ignore them and keep going with your speech. (neutral)	You have your speech ready and you get up to talk, and you hear people in the crowd laughing. (no intrusion)
You see a job advertised that you would really like, so you apply and are asked to interview. At the interview, you answer the questions as well as you can. That evening, you think that your answers decided the outcome.	I figure I probably didn't get the job because I never have the answers that interviewers seem to want to hear. (other negative)	You answer the questions as best you can and after the interview you think that your answers will determine the outcome of whether or not you will get the job. (no intrusion)	I'm looking forward to hearing from the interview regardless of whether I got it or not. I think interviewing is a good experience and I need more of it. (positive)	I answer the questions to the best of my ability and then I go home, thinking that I did a good job of answering the questions (positive intrusion)

Note. The first sentence of the scenario was provided to cue recall. GSP = Generalized Social Phobia.

Table 2
Characteristics of the Samples, Experiment 1

Variable	Generalized Social Phobia	Control
Gender	20 F, 12 M	20 F, 12 M
Age in years *M (SD)*	31.4 (10.48)	34.9 (11.05)
College graduate	59.4%	75.0%
English 1st lang	87.5%	93.8%
Comorbid Dx	15.6%	
PEP *M (SD)*	53.9 (17.81)	21.2 (15.38)
SADS *M (SD)*	21.9 (4.09)	4.2 (3.81)
FNE *M (SD)*	25.0 (6.25)	7.0 (6.39)
SPAI *M (SD)*	133.4 (28.45)	45.2 (26.99)

Note. $n = 32$. English 1st lang = percentage of native English speakers; Comorbid Dx = current comorbid diagnoses; PEP = Postevent Processing Questionnaire; SADS = Social Avoidance and Distress Scale; FNE = Fear of Negative Evaluation Scale; SPAI = Social Phobia Anxiety Inventory.

Initial Interpretation of Social Scenarios

Table 3 contains mean percentages of social scenarios that were interpreted within each emotion category. The means are collapsed across conditions of thought-induction procedures.

Socially anxious and otherwise negative continuations. Socially anxious participants produced significantly more socially anxious continuations to the ambiguous social scenarios than did the controls, $F(1, 60) = 23.16$, $MSE = 206.55$, $p < .001$, $\eta^2 = .28$. Continuations of social scenarios coded as *other negative* were also produced more frequently by the GSP participants than by the controls, $F(1, 60) = 7.85$, $MSE = 90.62$, $p = .007$, $\eta^2 = .12$.

Neutral and positive continuations. The analysis of continuations to social scenarios coded as neutral yielded a significant main effect for group, $F(1, 60) = 13.33$, $MSE = 385.26$, $p = .001$, $\eta^2 = .18$; control participants produced more neutral continuations than did GSP participants. In addition, the analysis of positive continuations to social scenarios revealed a main effect for group that approached significance, $F(1, 60) = 3.96$, $MSE = 152.72$, $p = .051$, $\eta^2 = .06$: control participants generated more positive interpretations than did GSP participants.[1]

Memory Intrusions

The raters scored an intrusion in recall of social scenarios if participants included nonpresented details; intrusions therefore ranged from 0 to 10. In the analysis of overall percentage of intrusions, regardless of their meaning, we found a main effect for group that approached significance, $F(1, 60) = 3.10$, $MSE = 354.04$, $p = .083$, $\eta^2 = .05$. A greater percentage of the social scenarios recalled by the controls contained intrusions than did those recalled by GSP participants ($M = 49.1$ vs. 40.8, respectively). Thus, socially anxious participants were clearly not less accurate in general than were controls.

Next, we analyzed the percentage of intrusions in recalling social scenarios that reflected the meaning of the corresponding continuations. If socially anxious participants experience greater difficulty in making memorial distinctions between social events and their interpretations, their recall of social scenarios should contain more intrusions that reflect their initial interpretations of the scenarios. Indeed, the main effect for group was significant,

$F(1, 60) = 6.67$, $MSE = 468.70$, $p = .012$, $\eta^2 = .10$. The GSP participants produced more of these intrusions ($M = 34.4$) than did the control participants ($M = 20.5$). The question still remains, however: Were GSP participants' memory difficulties restricted to situations that had evoked emotionally negative interpretations?

To answer this question, we recorded the category of the initial continuation that corresponded to each intrusion in the recall of social scenarios. The dependent variable was the percentage of intrusions that reflected continuations according to each emotion category, separately. Table 4 presents these means, collapsed across induction condition. In the category of social anxiety, the analysis yielded a main effect for group that approached significance, $F(1, 60) = 3.95$, $MSE = 140.12$, $p = .051$, $\eta^2 = .06$. A similar group difference was obtained in the "other negative" category, $F(1, 60) = 5.11$, $MSE = 237.33$, $p = .027$, $\eta^2 = .08$. Differences in the neutral and positive categories were nonsignificant ($p = .544$ and .399, respectively). In short, GSP participants produced a larger percentage of intrusions that reflected emotionally negative continuations but not other types.

We also analyzed the percentage of the five idea units accurately recalled from social scenarios (across raters, ICC = .96). GSP participants recalled 47.8, on average, whereas the controls recalled 45.0. This group difference was nonsignificant, $F < 1.0$. The main point, however, is that GSP participants' source-monitoring errors were not accompanied by poorer memory for the details.

Mood Measures and the Failure of the Thought-Induction Manipulation

Scores on the personal-characteristics questionnaire consisted of ratings of anxiety and nervousness throughout the session and were used to indicate any change in anxiety levels across the four administration time points: the beginning of the session, following the social interaction, after the induction, and at the end of the session. These ratings served to test the efficacy of the thought-induction manipulation with respect to mood. The dependent variable for this analysis was the mean of the anxiety and nervousness ratings at each point. A mixed-design ANOVA was conducted, with a within-subjects factor for time (the four times of administration) and between-subjects factors for group and thought induction. The analysis revealed a significant main effect for time, $F(3, 174.64) = 7.57$, $MSE = 0.60$, $p < .001$, $\eta^2 = .11$.[2] Change within pairs of adjacent time periods was evaluated; the only significant change occurred between ratings following the conversation with the confederate and ratings following the induction, $F(1, 60) = 8.89$, $MSE = .93$, $p = .004$, $\eta^2 = .13$ ($M = 3.2$ beginning of the

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[1] Continuations to the nonsocial scenarios, included as fillers, were examined in an exploratory query about the specificity of our results. These scenarios did not lend themselves to threatening interpretations, and socially anxious continuations were almost nonexistent ($M = 0.15\%$). Controls and GSP groups produced similar levels of other-negative, neutral, and positive continuations, $p > .20$. We also examined the classifications of recalled social-scenario continuations according to emotion categories. The pattern of continuation recall was identical to the pattern of initial interpretations.

[2] Degrees of freedom are those associated with the Huynh-Feldt adjustment, due to violations of the sphericity assumption.

Table 3
Mean Percentages of Continuations (and Standard Deviations), Experiment 1

	Emotion category				
Group	Socially anxious	Anxious	Other negative	Neutral	Positive
Control	7.8 (7.97)	1.1 (3.55)	6.7 (6.93)	65.4 (16.46)	16.6 (14.12)
GSP	25.1 (18.61)	1.7 (3.05)	13.3 (11.30)	47.5 (21.82)	10.4 (10.12)

Note. $n = 32$. GSP = Generalized Social Phobia.

session, $M = 3.0$ following the conversation, $M = 2.6$ following the induction, $M = 2.7$ end of the session). Regardless of induction task or group, participants became less anxious or nervous. There was also a significant main effect for group, $F(1, 60) = 54.96$, $MSE = 6.14$, $p < .001$, $\eta^2 = .41$. As expected, the GSP participants rated anxiety and nervousness to be higher overall than did controls ($M = 4.0$ vs. 1.7, respectively). However, all effects associated with induction were nonsignificant, $Fs < 1.0$.

In employing a thought-induction procedure prior to requesting interpretations of scenarios, we expected to find that ruminative thought would exaggerate socially anxious biases in interpretations and, perhaps, in subsequent recall, or that distracting thoughts would reduce these biases. We did not find these effects. Moreover, the manipulation did not affect current mood states, as has the standard manipulation devised by Nolen-Hoeksema and Morrow (1993) and since used by others. In hindsight, the manipulation of rumination was weak. We used the 14 ruminative phrases that pertained most directly to the concerns of socially anxious individuals and presented each one for 30 s, in order to fill the (typical) 8-min period. Such an extended period likely permitted mind wandering. Thus, poor experimental control might explain the lack of effects of this procedure on measures of mood and cognitive bias. Future studies should pay particular attention to parameters of the manipulation of ruminative thought in order to maximize the success of this manipulation.

Summary

The main findings of Experiment 1 were (a) the replication of the frequently demonstrated interpretation bias in social phobia, and (b) new evidence for memory bias. GSP participants, more frequently than controls, produced intrusions in recalling social scenarios that reflected the meaning of their initial emotionally negative continuations. Various explanations might account for these source-monitoring errors. At first blush it might seem that attention to the details of the episode could be sacrificed in the service of attention to one's own reactions (Hope, Heimberg, &

Klein, 1990). Similarly, the mere elicitation of emotion might divert the focus of attention from the actual description. Accounts based on inattention, however, are challenged by the finding that the two groups recalled similar numbers of idea units. In a different vein, because mental imagery characterizes the thoughts of socially anxious individuals in social situations (see Hirsch, Clark, & Mathews, 2006), source-monitoring errors might reflect the extent to which people construct vivid mental images of themselves in the scenario and the subsequent continuation. Imagery would serve to integrate the continuation with the scenario.

Experiment 2

In an initial attempt to examine the role of imagery in producing source-monitoring errors, we selected emotional continuations reported by the GSP participants in Experiment 1 to present to university students in Experiment 2. We chose four socially anxious and four otherwise negative continuations, each of which had produced an intrusion in later recall of the corresponding scenarios. Neutral or slightly positive continuations of eight nonsocial scenarios were also presented. Students read the separated scenarios and endings under instructions either to form self-referential images or to consider the extent of closure provided by the ending. On the basis of the combined cognitive-biases hypothesis (Hirsch, Clark, & Mathews, 2006), we predicted that the construction of self-referential images would elevate intrusions.

Even more fundamentally, however, this experiment was conducted to evaluate whether intrusions of the sort produced in Experiment 1 by the GSP participants would also be produced when nonanxious individuals recall social scenarios with emotional continuations; consequently, we categorized students as low or high on a measure of social anxiety. If nonanxious and anxious participants produced similarly frequent intrusions, then we would not be able to rule out the sufficiency of emotional continuations (perhaps combined with imagery) in producing source-monitoring errors. If the two groups similarly failed to produce intrusions, we would suspect that self-generated interpretations are necessary for

Table 4
Mean Percentages of Intrusions in Recall, Reflecting Interpretations of Social Scenarios (and Standard Deviations), Experiment 1

	Emotion category					
Group	Socially anxious	Anxious	Other negative	Neutral	Positive	Total
Control	4.2 (8.10)	0.3 (1.47)	2.3 (4.63)	10.6 (12.17)	2.6 (5.91)	20.5 (16.20)
GSP	10.1 (14.45)	0.5 (2.74)	11.0 (21.26)	8.6 (13.58)	4.2 (9.07)	34.4 (26.34)

Note. $n = 32$. GSP = Generalized Social Phobia.

the production of source-monitoring errors. Finally, differences between these groups would signal the importance of social anxiety in producing these errors, perhaps because mental imagery is typically involved (Hirsch, Clark, & Mathews, 2006).

Method

Participants and Materials

Fifty-six students were recruited from an introductory psychology course at Trinity University in San Antonio, Texas. The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) had previously been administered, and students qualified for participation if they scored below 20 and above 30 (values arbitrarily chosen to differentiate the groups). Table 5 presents the mean scores in each condition. Because data from four students could not be used due to problems during tape recording, their data were replaced with the data from an additional four participants recruited from summer classes at the university. The final sample consisted of 56 students (34 female, equally divided between conditions).

We selected continuations that were not particularly unusual and that produced an intrusion in subsequent recall by a GSP participant in Experiment 1. To reflect the two dominant emotions in continuations of social scenarios in Experiment 1, we chose four socially anxious continuations of social scenarios ("Wedding Reception," "Local Club," "Evening Class," and "Local Pub") and four otherwise negative continuations of social scenarios; eight neutral or slightly positive continuations of nonsocial scenarios were also selected. Nonsocial scenarios were included as fillers to make our interests less salient. All scenarios and continuations are listed in the Appendix, the nonsocial ones in the first half of the list. Two social scenarios from Experiment 1 were omitted because the scenario failed to produce intrusions or because the continuations that produced intrusions were too distinctive; two nonsocial scenarios were also omitted, to keep the same balance as in Experiment 1.

Procedure

Participants were randomly assigned to instructions (subject to equal n). They were told that the computer would present a series of trials with two parts: The first part described a real-life scenario, and the second part described an ending to the scenario that was actually created by a previous participant. Current participants were asked to read the scenario and then press the space bar to initiate the display of the ending, which they should read aloud. The ending appeared at the bottom of the screen. In the imagery condition, participants were asked to imagine themselves as the central character performing the actions described in both parts and to make this image as vivid (clear and lifelike) as possible. When they pressed the space bar again, the scenario and ending were replaced by a 7-point rating scale ranging from *not at all* to *extremely vivid*, and participants typed their rating. In the closure condition, participants were asked to consider that each scenario could have ended in other ways or that the ending could have better resolved the ambiguity of the scenario. In this condition, the rating scale ranged from *not at all* to *very well*, and participants rated the extent to which they thought the ending provided closure to the situation. As in Experiment 1, the scenarios were randomized anew for each participant. Following three practice trials, the experimenter left the room, and readings were tape recorded to insure that instructions were followed.

Following the 3-min digit/symbol-substitution task, the memory task was announced. On each trial, participants first read the displayed title and first sentence of the scenario. Then they attempted to recall the remainder of the scenario aloud, having been told that the main ideas were more important than the exact wording. Upon pressing the space bar, the instruction to recall the ending appeared; participants said, "the ending" and then attempted to recall it aloud. The next trial began when the space bar was pressed a second time. Again, following three practice trials, the experimenter turned on the recorder and left the room. In a final task, the scenarios and endings were shown on the same screen, in random order. Participants were instructed to judge the likelihood that they would act or react in the same or a similar way as the description in each ending. Ratings were made on a 7-point scale ranging from *not at all* to *extremely likely*. All computer tasks were implemented with Superlab Pro software (Version 4.0, Cedrus Corp.).

Results and Discussion

Two raters, blind to experimental conditions, independently classified the recalled social scenarios from 52 participants according to whether they contained intrusions reflecting the endings (averaged $\kappa = .83$). The percentages of intrusions were averaged across the raters and submitted to an ANOVA, with between-subjects factors for group (low vs. high SIAS) and instruction (imagery vs. closure). The interaction was significant, $F(1, 52) = 5.52$, $MSE = 129.31$, $p = .023$, $\eta^2 = .10$. Means in Table 5 show that, compared with closure, imagery instructions encouraged intrusions by low-anxious students, $F(1, 26) = 7.69$, $MSE = 132.32$, $p = .010$, $\eta^2 = .23$, but not by high-anxious students, $p = .604$. The group difference was significant for those with closure instructions, $F(1, 26) = 13.48$, $MSE = 69.97$, $p = .001$, $\eta^2 = .34$, but not imagery instructions, $p = .610$.

Ratings of identification with the endings of the social scenarios were also analyzed with the same design; data were missing for one participant. The significant main effect of group revealed greater identification by participants with higher SIAS scores, $F(1,$

Table 5

Distributions and Means in Experiment 2 (and Standard Deviations)

| | Imagery | | Closure | |
| | Low anxious | High anxious | Low anxious | High anxious |
Group				
Gender	8 F, 6 M	9 F, 5 M	9 F, 5 M	8 F, 6 M
SIAS	9.1 (3.86)	40.4 (6.94)	10.4 (5.36)	40.5 (7.84)
Intrusions	17.4 (15.15)	14.7 (12.16)	5.4 (5.93)	17.0 (10.23)
Identification	3.4 (0.84)	4.8 (0.65)	3.6 (1.07)	4.2 (0.93)

Note. The last measure is missing data from one participant in the low-anxious closure condition; otherwise, $n = 14$. SIAS = Social Interaction Anxiety Scale; intrusions = percentage of the 8 social scenarios for which recall included an intrusion reflecting the meaning of the ending; identification = rating of similarity of the ending to one's own actions or reactions (7-point scale).

51) = 19.52, *MSE* = 0.78, *p* < .001, η^2 = .28. The means in the last row of Table 5 show that these ratings did not differ according to instructions, and the interaction was not significant, *p* = .110.

From the standpoint of the issues motivating this experiment, it is clear that intrusions of the sort produced in Experiment 1 by the GSP participants can also be produced when nonanxious individuals recall social scenarios with emotional continuations. Students with lower SIAS scores made errors at the same level as those with higher SIAS scores, but only if they constructed vivid images of themselves as the main characters of the scenarios. Although we have no direct evidence, it seems likely that the socially anxious students in Experiment 2 automatically imagined themselves in these scenarios, regardless of instruction to consider closure. In general, these results suggest that both the availability of emotionally negative interpretations and vivid images contribute to the memory biases observed in Experiment 1. Of course, it is not possible to compare these levels of intrusions with those produced by GSP participants on the basis of their idiosyncratic interpretations. Nevertheless, the fact that imagery instructions elevated intrusions produced by students otherwise less inclined to identify with the main characters does suggest that imagery played an important role in Experiment 1 as it has in other studies of cognitive bias in social anxiety (see Hirsch, Clark, & Mathews, 2006).

General Discussion

Experiment 1 is one of the first studies to provide evidence for a connection between interpretation and memory biases in GSP. Consistent with the existing literature on interpretation bias, socially anxious individuals generated more socially anxious and otherwise negative continuations to social scenarios than did their nonanxious counterparts. Moreover, errors in recalling those scenarios reflected the nature of their initial emotionally negative interpretations, thereby blurring the distinction between memory for the scenario and memory for their own thoughts and interpretations and providing a new way to understand memory biases in social anxiety. In Experiment 2, undergraduate students who read continuations provided by the GSP participants produced the same kind of memory intrusions if they were instructed to imagine themselves as the main characters or if they scored high on self-reported social anxiety.

The Present Findings

Our first hypothesis was that the GSP participants would exhibit an interpretation bias for ambiguous social scenarios. The socially anxious participants did indeed generate more socially anxious continuations, and they also generated more other negative and fewer neutral continuations of social scenarios than did the control participants. Finally, the GSP participants tended to generate fewer positive interpretations than did the controls (although the effect merely approached significance). In general, these results are consistent with the interpretation bias literature in social phobia (e.g., Amir et al., 2005; Brendle & Wenzel, 2004; Mellings & Alden, 2000).

Approximately one-fourth of the interpretations made by the GSP participants were categorized as socially anxious. This seemingly low number is related to the characteristics of our materials

in a way that reflects the fundamental nature of the research design. The 10 social scenarios represented a variety of social situations (e.g., speaking in public, having an interview, going to a social club). Because a diagnosis of GSP encompasses a wide spectrum of social fears, it is likely that each GSP participant's feared social situations corresponded to only a small number of the scenarios used in this study. (In recruiting the GSP participants, however, we ensured that they had experienced social phobia for at least two different social situations in the past 2 months.) Thus, the breadth of the scenarios used for the purpose of capturing individual differences likely minimized the average number of socially anxious interpretations and subsequent associated intrusions.

Supporting our primary prediction, GSP participants produced more source-monitoring errors during the recall of social scenarios than did participants in the control group, who tended to produce more intrusions overall regardless of meaning. It is not the case, therefore, that the GSP participants were simply more willing to make errors in recall; consequently, a response-bias explanation can be ruled out. Source-monitoring errors were more frequent for the GSP participants when their continuations of the social scenarios had been socially anxious or otherwise negative (albeit not strictly at the level of statistical significance in the case of socially anxious continuations). This outcome is partly a function of opportunity; because the GSP participants produced more emotionally negative continuations, there were more available for confusion with memory for the actual scenarios. Although opportunity is sometimes seen as the cause of artifact, we stress its role as foundation for memory bias, which in turn contributes to the maintenance of the disorder. GSP participants are more likely to make emotional interpretations of ambiguous or benign social situations, and these interpretations provide grounds for source confusions in later recall. Thus, negatively distorted memories, rooted in such opportune interpretations, encourage avoidance of future social situations (see Hackmann, Clark, & McManus, 2000).

In Experiment 2, opportunity was standardized through the provision of endings to the scenarios. From this experiment we learned that naturally occurring interpretation biases are not necessary to the construction of source-monitoring errors. Because we assume that people are infrequently provided with interpretations of ambiguity in the real world, however, opportunity is still an ecologically important feature of the phenomenon. The other lesson from Experiment 2 is that self-focused imagery contributes substantially to the production of source-monitoring errors. And indeed there is reason to believe that self-focused imagery actually encourages biased interpretations in the first place (see Hirsch, Mathews, & Clark, 2006). Therefore, the availability of negative interpretations might not be sufficient to the production of source-monitoring errors, even for socially anxious individuals, unless self-focused imagery is also engaged. Future investigations should examine the possibility that self-generated emotional interpretations reduce initial attention to details that would facilitate source monitoring, particularly in the context of self-referential imagery. In that regard, however, we note that the GSP participants in Experiment1 recalled as many idea units as did the controls.

Future investigations should also test the specificity of the differences observed in these experiments. We did not include scenarios that were ambiguous in features other than social threat. Although frameworks for understanding social anxiety do not

anticipate biases in interpretation or recall of events that can be interpreted as physically threatening, for example, it is possible that source-monitoring errors would extend in ways that reflect diagnostic overlap, perhaps especially with regard to potential depressive interpretations.

Memory Bias in Social Anxiety

There are several possible reasons why Experiment 1 is one of the few to find evidence of memory biases in socially anxious individuals. First, our procedure began with an interaction with a confederate, which may have helped activate cognitive biases among the GSP participants. In one of the few other studies obtaining evidence of biased recall in social anxiety, Mellings and Alden (2000) also began their sessions with a confederate interaction. Mansell and Clark (1999), too, employed a similar real-life scenario concerning fear of public speaking. It is possible that an ongoing social situation is necessary to the production of interpretation-based memory biases in social phobia.

Unlike other studies of recall bias in social anxiety, we examined interpretations and memory interactively, as part of the central rationale for the study. This point is likely to be important in understanding why evidence for biased memory is found infrequently in other studies. For example, in a number of investigations, participants were asked to recall single words or sentences without reference to interpretation, usually because their meaning was unambiguous (e.g., Amir et al., 2000; Becker et al., 1999; Cloitre et al., 1995; Studies 1 and 2 by Rapee et al., 1994; Rinck & Becker, 2005; Sanz, 1996). A few investigators (e.g., Brendle & Wenzel, 2004; Wenzel et al., 2005) examined both interpretive and memory biases for the same materials but tested only memory for factual details. Although the attempt to separate the biases is certainly justifiable, our source-monitoring perspective suggests that evidence for memory biases in social phobia rests on the use of a paradigm capable of revealing influences from interpretations. Interestingly, Lundh and Ost (1997) provide early evidence from such a paradigm. Social phobic participants recognized more faces that they had previously judged to be critical (instead of accepting), whereas controls exhibited the opposite pattern. Methods that reveal interactions between interpretation and memory provide more ecologically valid analogs for the operation of interpretation and memory biases outside the laboratory, where the meaning to be found in social events is often ambiguous.

Our emphasis on interpretive aspects of recall is consistent with recent evidence on phenomenal aspects of autobiographical memory in social phobia. D'Argembeau, Van der Linden, d'Acremont, and Mayers (2006), for example, found that compared with controls, participants with social phobia rated their memories of social events as containing fewer details; these memories made more references to self, but they also tended to reflect an observer's perspective on self. Similarly, Coles, Turk, and Heimberg (2002) examined GSP and control participants' memory for role-played interactions at two time points: the same day and 3 weeks later. Initially, memories in the GSP group were rated more in accord with an observer's perspective and less with a field perspective than memories in the control group, and this difference increased 3 weeks later. Clearly, qualitative aspects of memories warrant more attention in future studies of cognitive functioning in social anxiety.

Reality Monitoring, Source Monitoring, and Reconstructive Memory

Our contribution to the literature on memory biases is based on reasoning about errors in reality-monitoring—errors in remembering the source of the event in question ("Did I experience it or merely imagine it?"). In fact, our procedure for the memory task encouraged the consideration of source, in that participants were required to distinguish aloud on each trial the line that separated the scenario from the continuation. It is important to realize, however, that the two memory sources relevant to Experiment 1 were printed descriptions of scenarios and self-invented continuations, stated aloud. Source monitoring likely involved attempts to remember descriptions as they appeared on the monitor instead of actual events with good perceptual detail, as would be the case in real-world reality monitoring. Words on a monitor are indeed externally generated memory representations, but they might be more easily separated from the products of one's imagination than would be the case for actual events. Alternatively, our participants' source discriminations were complicated by the fact that we instructed them to see themselves as the central character in the scenario and asked them to speak continuations aloud. In Experiment 2, source monitoring required participants to distinguish between two printed descriptions. In short, our demonstrations of source-monitoring errors imprecisely model real-world reality-monitoring tasks, likely underestimating potential confusions in some ways and overestimating them in others.

The real-world problem of reality monitoring is more clearly approached from the perspective initially established by Johnson and Raye (1981), who proposed that internally generated memories are characterized by records of the cognitive processes that produce them (e.g., memory for having actually made an interpretation), whereas externally generated memories are characterized in part by richer perceptual attributes. In social anxiety, tendencies to construct vibrant visual images of interpretations would make source confusions more likely. Any tendency not to monitor one's thoughts would also add to source confusions by creating dim records of the process (not the product) of interpretation. By considering these and other memory attributes, applications of a reality-monitoring analysis to problems in social phobia offer rich possibilities for further research.

Conclusions

Our results highlight the connection between socially anxious individuals' biases in interpretation and memory. Speculating about the tendency to blur the lines between these phenomena, Hirsch, Clark, and Mathews (2006) wrote: "Even if the original event was really neutral or only mildly negative, but was interpreted at the time in a catastrophic way, then the stored memory is also likely to contain elements of the catastrophic interpretation, perhaps incorporated into the remembered image of the event" (p. 230). Here, we offer empirical support for their speculation; socially anxious individuals' biased interpretations do affect what they remember about a social interaction. And these distorted memories are therefore available to color future interpretations of benign situations.

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(Appendix follows)

Appendix

Materials in Experiment 2

Scenario	Ending
Your Exam Review: You draw up a plan for your exam revision and encourage yourself to stick to it. The next day you come home and go straight to your room. When your roommate comes home you are working.	I say hi to my roommate and go back to doing my work.
The Gift: Your aunt sends you a hat for Christmas. Her choice of a gift is unusual, because you do not wear hats. You try it on; the hat is warm because it is thermal.	I forget that I do not like hats and just keep it on because it's comfortable.
The Dining Set: You inherit an old dining table and chairs and decide to restore them to their former glory. You spend hours in the garage working on them. When you have finished, you bring them into the house.	I put various decorations on top of the table.
Your New Hobby: You decide to take up pottery as a hobby. You go to the art store and buy all the materials. When you work with the clay you think you should have bought an apron.	I changed into an old t-shirt and decided to get an apron the next day.
The Exercise Regimen: You want to start jogging again and plan to go out every morning before work. On the first morning, you have run a short distance before you notice that it's chilly. You forgot to bring gloves.	I pick up the pace so I can get my adrenaline going and feel warm.
The Video Camera: You buy a new video camera and take it home. The camera doesn't work, so you go to the store to get a refund. When you look into the bag the receipt is missing.	I'll see if the clerk can take it back just using my credit card.
The Book: You begin reading a book that you recently found around your house. One afternoon you are reading it while sitting in the recliner. The doorbell rings so you put the book down.	I decided not to answer it, the book is too good.
Your New CD: You heard a song on the radio and went out to buy the CD right away. When you return home you listen to it on your stereo and turn the volume up. After a few songs, you regret the purchase.	I'll sell the CD back to the store that buys used CDs.
The Wedding Reception: Your friend asks you to give a speech at her wedding reception. You prepare some remarks and when the time comes, get to your feet. As you speak, some people in the audience start to laugh.	I'll wrap up my speech as quickly as I can, as I fear that they are laughing at me.
The Local Club: You are invited to attend a social at a local club, whose members you don't know very well. As you approach the door you hear loud conversation. When you enter the room, it stops.	I guess I look pretty weird in the club; I'm not the typical person you'd find at a club.
The Job Interview: You see a job advertised that you would really like, so you apply and are asked to interview. At the interview, you answer the questions as well as you can. That evening, you think that your answers decided the outcomes.	I could have done better. I'm pretty sure I won't get hired.
Meeting a Friend: In the street you bump into an old friend you haven't seen for a long time, but she is in a rush. You arrange to meet later in a bar. You arrive on time and a few minutes later she is still not there.	I knew I shouldn't have come. This happens all the time.
Your Birthday: It is your birthday and you wake up looking forward to your day. You wonder how many friends will call to wish you happy birthday. By the time you leave for work, no one has called.	I feel deflated and disappointed but go back to work anyway and hope that someone remembers my birthday.
The House-Warming Party: Your neighbor has a house warming party and you are invited. You arrive to find many other guests whom you do not know. You try talking to some of them, and you get an impression of their interest in your conversation.	I hate these parties. There is never anyone good to talk to.
The Evening Class: You have just started going to an evening class in philosophy. The instructor asks a question and no one answers, so he looks directly at you. You answer the question, aware of how your voice must sound.	I realize my voice sounds high pitched because I am nervous so I intentionally lower it and speak a little more slowly.
The Local Pub: You are with a group of new friends at a local pub. You start to tell a joke you heard recently, and everyone looks at you. Their expressions change when you get to the punch line.	I didn't tell the joke right. I guess I'm not a very good joke teller.