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Social Anxiety and Social Behavior: A Test of Predictions From an Evolutionary Model

Erin B. Tone[1,2], Eddy Nahmias[2,3], Roger Bakeman[1], Trevor Kvaran[4], Sarah F. Brosnan[1,2,3], Negar Fani[5], and Elizabeth A. Schroth[6]

[1]Department of Psychology, Georgia State University; [2]Neuroscience Institute, Georgia State University; [3]Department of Philosophy, Georgia State University; [4]Harris Insights and Analytics, Rochester, New York; [5]Department of Psychiatry and Behavioral Sciences, Emory University; and [6]Transitional Insights, LLC, Olney, Maryland

Abstract

An influential evolutionary model proposed that social anxiety biases people to treat social interactions as competitive struggles with the primary goal of avoiding status loss. Among subordinate nonhuman primates in highly hierarchical social groups, this goal leads to adaptive submissive behavior; for humans, however, affiliative responses may be more effective. We tested three predictions about social anxiety and social cognitions, emotions, and behavior that Trower and Gilbert advanced. College students ($N = 122$) whose self-reported social anxiety ranged from minimal to extremely high played the Prisoner's Dilemma game three times. Consistent with two model-based predictions, social anxiety was positively associated with self-reported competitive goals and with nervousness during game play. Unexpectedly, however, social anxiety was associated with a tendency to engage with coplayers in an ostensibly hostile, rather than appeasing, manner. We discuss implications of these findings for updated models of socially anxious behavior.

Keywords

social anxiety, prisoner's dilemma, evolutionary model, interpersonal interaction

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Fear of evaluation from others, both during and in anticipation of social encounters, is a cardinal feature of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997; Weeks, Heimberg, Rodebaugh, & Norton, 2008). This fear commonly leads people to withdraw or to engage in safety behaviors—actions aimed at maintaining a sense of safety in interpersonal contexts that feel threatening (Piccirillo, Dryman, & Heimberg, 2016). For example, when they feel socially anxious, people often avoid or break eye contact, defer to others' preferences, or adjust their nonverbal behavior to make themselves less imposing (e.g., Langer & Rodebaugh, 2013; Terburg, Aarts, & van Honk, 2012; Terburg et al., 2016; Walters & Inderbitzen, 1998; Weeks, Howell, & Goldin, 2013; Zimmerman, Morrison, & Heimberg, 2015). Paradoxically, this self-protective behavior tends to backfire, eliciting unfavorable responses from others that further fuel anxiety (Piccirillo et al., 2016).

Paul Gilbert and colleagues (e.g., Gilbert, 2001, 2014; Gilbert & Trower, 2001; Trower & Gilbert, 1989) developed an influential evolutionary model of social anxiety, tracing its origins to a phylogenetically old bias to conceptualize social interactions as competitive struggles in which key goals are to dominate or to avoid rejection or status loss. This bias makes sense in despotic nonhuman primate (NHP) species' social groups, which are organized around strict dominance hierarchies. In these NHP groups, social interactions frequently unfold in what the ethologist and pharmacologist Michael Chance (Chance, 1967; Chance & Jolly, 1970) labeled an "agonic" or conflict-oriented mode. Thus,

Corresponding Author:
Erin B. Tone, Department of Psychology, Georgia State University, P.O. Box 5010, Atlanta, GA 30302-5010
E-mail: etone@gsu.edu

subordinate individuals live in a stressful state of braced readiness (Chance, 1980), continually monitoring the social environment for threats from more dominant group members. When threats emerge, subordinate group members, who feel ill equipped to achieve safety by challenging the dominance structure, tend to opt out of competing. Instead, they withdraw or send submissive or appeasing signals to dominant aggressors. Such behavior enables subordinate individuals to maintain group membership and avoid slipping farther in the social hierarchy, thus preserving access to vital resources (Drews, 1993). It also helps restore a level of peace and cohesion in the group by stabilizing and reinforcing the hierarchical structure; this stabilization, in turn, helps decrease stress levels among group members (Sapolsky, 2005).

In more egalitarian primate species, including humans, not only does social competition take place in the agonic mode, with a focus on matters of status or dominance, but it can (and often does) also occur in what Chance termed the hedonic mode, in which the focus is instead on achieving affiliative goals (Chance, 1967; Chance & Jolly, 1970). Behaviors produced in the hedonic mode aim to attract and hold positive attention from others to enhance one's own sense of belonging and to garner prestige (Gilbert, 1997, 2001, 2014; Price, 1992). In both humans and less despotic NHP species, and even at times within NHP species that are quite despotic, hedonic mode interactions include cooperation (e.g., de Waal, 1982; Tomasello & Gonzalez-Cabrera, 2017), intervention to help resolve conflicts (e.g., Flack, de Waal, & Krakauer, 2005; Flack, Girvan, de Waal, & Krakauer, 2006; Halevy & Halali, 2015; von Rohr et al., 2012), and formation of coalitions and alliances with conspecifics of different status levels (e.g., Snyder, 2007; Snyder-Mackler, Alberts, & Bergman, 2012). Humans engaging in the hedonic mode commonly exhibit such behaviors as social approach and initiation, asserting oneself, and talking a lot (e.g., Anderson, John, Keltner, & Kring, 2001; Burgoon, Johnson, & Koch, 1998; Riggio, Riggio, Salinas, & Cole, 2003), as well as (at least under some circumstances) showing generosity (e.g., Halevy, Chou, Cohen, & Livingston, 2012). For both humans and NHPs, hedonic behavior increases belonging and facilitates the development, maintenance, and repair of long-term relationships (Agnew & Le, 2015; Aureli & de Waal, 2000; de Waal & van Roosmalen, 1979; Silk, Alberts, & Altmann, 2006; Smuts, 1985) that enhance longevity and health (Holt-Lunstad, 2018; Silk, Alberts, & Altmann, 2003; Silk et al., 2010).

In more egalitarian primate societies, effective social functioning depends on a capacity to shift fluidly between the agonic and hedonic modes in response to dynamically changing cues that signal whether others will be friendly and accepting or critical and hostile. People who are vulnerable to social anxiety, however, show an inflexible bias to view social interactions—even those that most people would perceive as safe—through an agonic, rather than a hedonic, lens (e.g., Gilbert, 2014; Trower & Gilbert, 1989). They are thus prone to behave like subordinate animals of more despotic species that are trying to avoid physical harm or blocked access to resources: They withdraw (Weeks, Rodebaugh, Heimberg, Norton, & Jakatdar, 2009), for example, or engage in safety behaviors (Terburg et al., 2016; Weeks, Heimberg, & Heuer, 2011). Rather than being concerned about threats to their physical well-being, however, people experiencing social anxiety are typically concerned about psychological threats, particularly that others will perceive them as inferior or unworthy and will thus shame or humiliate them (Gilbert, 2000, 2007).

When they initially presented their model, Trower and Gilbert (1989) advanced hypotheses about human social anxiety and how the agonic bias that it introduces should influence behavioral choices in interpersonal contexts perceived as competitive. In the present study, we tested three of these hypotheses using data from an iterated version of the Prisoner's Dilemma (iPD) game, an experimental task adopted from the economic exchange literature (de Quervain, 2004; Fehr & Rockenbach, 2004; King-Casas et al., 2005; McCabe, Houser, Ryan, Smith, & Trouard, 2001; Rilling et al., 2002; Sally, 2003). In the iPD game, two players make independent choices over the course of several trials about whether to cooperate with each other. This task lends itself well to the study of social anxiety, which arises before and during dynamic and reciprocal interactions in which "the signals of one person(s) affect the feelings and behavior of another" (Gilbert, 2001, p. 726). Moreover, players typically experience both rewarding and punitive interactions that influence subsequent behaviors; that can evoke strong feelings (e.g., McClure et al., 2007; McClure-Tone et al., 2011) in complex, real-life ways; and that can be mathematically modeled (Fehr & Camerer, 2007).

The first prediction that we tested stems from Trower and Gilbert's (1989) proposition that, as a function of the tendency of those who are socially anxious to operate in an agonic or dominance-focused mode rather than a hedonic or connection-focused mode, "the primary desired self-identity for socially anxious people . . . is to be more dominant and have higher status . . . than the other or others" (p. 26). If this proposal is accurate, then social anxiety should be associated with prioritization of status-related or competitive goals over other, more hedonically oriented social goals—such as communal affiliation or helping or supporting others—that have been identified in the literature (e.g., Findley & Ojanen, 2013).

Second, Trower and Gilbert (1989) suggested that although people high in social anxiety strive for status, "they have low expectations of being able to construct and/or maintain this identity, and therefore would have high anxiety about attempting a dominance strategy" (p. 27). Thus, in competitive social contexts that offer opportunities for dominant behaviors, social anxiety should be associated with vulnerability to distress, regardless of whether the individual ultimately acts in a dominant way. Considerable evidence indicates that the potential for dominance or success is distressing for people who endorse high levels of social anxiety, possibly because dominant or assertive behavior could elicit negative attention from those currently in dominant positions (e.g., Weeks et al., 2009). Indeed, findings from several studies show that people with high levels of self-reported social anxiety, as well as those with social anxiety disorder (SAD), experience positive social feedback as unpleasant because it might set them up for more stringent social demands that they cannot meet, as well as consequent social reprisals (e.g., Alden, Taylor, Mellings, & Laposa, 2008; Vassilopoulos & Banerjee, 2010; Weeks, 2010). There is also evidence that anxiety, more broadly construed, is negatively associated with adults' endorsement of positive affect, enjoyment, and excitement when they are asked to imagine themselves in powerful roles (Maner, Gailliot, Menzel, & Kunstman, 2012).

Third, Trower and Gilbert (1989) proposed that the more discrepant a desired outcome (e.g., maintained or increased social status or belonging) is from the expected outcome (e.g., humiliation or rejection), the more likely a person vulnerable to social anxiety is to cut losses and fall back from a risky competitive strategy to a safer, yet still agonic, approach. For example, rather than asserting dominance or responding hedonically (e.g., engaging in mutual cooperation), one might enact safety behaviors that carry fewer potential rewards but also can circumvent losses that are perceived as likely. Given that social anxiety is associated with the tendency to view negative social outcomes as both likely and costly (Nelson, Lickel, Sy, Dixon, & Deacon, 2010), it should also relate to a tendency to experience discrepancies between desired and expected outcomes and, consequently, to engage in behavior that seems incompatible with a desire to keep or enhance social status.

In the context of the iPD game, there are at least two types of possible responses that are incompatible with status enhancement. In the first type of response, consistent with Trower and Gilbert's (1989) expectation that anxious people will engage in appeasing behavior, an individual will cooperate after the other player has defected—presumably offering a discordant response in an effort to avert further defection from the coplayer. In our previous research using the iPD, for example, adolescents with anxiety or depressive disorders approached play in a more appeasing way, responding cooperatively to their coplayer's choices in the previous round, even when those overtures were competitive, more often than did those without diagnoses (McClure et al., 2007; McClure-Tone et al., 2011). Differences emerged in terms of neural correlates of task performance as well: In response to feedback about trial outcomes, anxious youths showed stronger activation than did nondiagnosed peers in frontoparietal regions of the brain, which have been implicated in self-reflection and evaluation of others' social behavior (McClure-Tone et al., 2011).

Other research has linked a second pattern of discordant economic exchange behavior that is incompatible with status enhancement with social anxiety. Rodebaugh and colleagues used a 40-round variant of the iPD game to examine impaired friendship behavior in samples of adults with both high self-reported social anxiety and diagnosed SAD (Rodebaugh, Klein, Yarkoni, & Langer, 2011; Rodebaugh et al., 2013). The task variant in these studies blended elements of another economic exchange task—the Dictator Game—into the classic iPD structure. Thus, unlike typical iPD games, which involve electing during each trial either to cooperate with another player or to defect, participants repeatedly divided 10 tokens between themselves and a computerized "coplayer" whom they were instructed to think of as a friend, a stranger, or a computer.

In these studies, both clinical and self-reported social anxiety were associated with a pattern of behavior that seems inconsistent with a desire to maintain or improve social status but that deviated from the submissive pattern that McClure-Tone and colleagues (McClure et al., 2007; McClure-Tone et al., 2011) found in anxious and depressed youths. Instead, social anxiety was associated with a constellation of behaviors that the authors termed "interpersonal constraint" and that involved discomfort with others' conferral of favors (i.e., when others gave them tokens) and failure to reciprocate positive social behaviors. This discomfort was particularly evident in interactions involving imagined friends. Moreover, interpersonal constraint was observed both in general and following the coplayer's defection, which suggests that it did not exclusively constitute a response to perceived betrayal or rejection. Notably, in subsequent research from this group, findings indicated that several characteristics, particularly vindictiveness or a lack of empathy, better predicted interpersonal constraint than did SAD (Rodebaugh, Heimberg, Taylor, & Lenze, 2016; Rodebaugh et al., 2017).

The Present Study

We used iPD data gathered from a sample of college students (who self-reported their levels of social anxiety online before taking part in an in-person iPD game session) to test the three aforementioned predictions based on Gilbert and colleagues' model of social anxiety. Our first hypothesis was that greater social anxiety would be associated with competitive goals and higher ratings of the importance of winning. Second, we hypothesized that greater social anxiety would be associated with self-reports of greater distress—specifically feeling more nervous during the game and less positive toward the coplayer after the game. Finally, we predicted that social anxiety would be associated with behaviors during the game that appear incompatible with a desire to keep or enhance social status. Specifically, we predicted that higher social anxiety would be associated with an atypically noncontingent and appeasing pattern of play, defined as cooperating following a coplayer defection, in line with Gilbert and colleagues' model (Gilbert, 2014; Trower & Gilbert, 1989) and our own prior findings with the iPD game. Finally, given mixed evidence about whether participants respond differently when they believe that they are playing with a real person as opposed to a computer algorithm (e.g., Kätsyri, Hari, Ravaja, & Nummenmaa, 2013; Kiesler, Sproull, & Waters, 1996), we conducted exploratory analyses comparing these two conditions.

Method

Participants

Potential participants (N = 165; 64% women) were recruited from a research participation pool based in the psychology department at a large urban university. Data from 19 of the potential participants were excluded: 13 who reported disbelief that they were playing with a real (rather than a computerized) coplayer, 2 for whom the game was discontinued early because of technical problems, and 4 for whom data quality was questionable. Data from 18 further participants were excluded because they either never cooperated or never defected for one or more full games, thus precluding calculation of a key study variable, the risk-difference score, described in detail below. To increase coherence and aid interpretability, we excluded data from an additional 6 age outliers (ages 34–54 years), resulting in a final sample of 122 men and women in their late teens and 20s (69% women). Included and excluded participants did not differ significantly in level of self-reported social anxiety on the Liebowitz Social Anxiety Scale–Self-Report version (LSAS-SR; Baker, Heinrichs, Kim, & Hofmann, 2002), $t(162)$ = 1.35, p = .18. The median age for the final sample was 20 years; the mean age was 20.9 years (SD = 2.83).

Measures and procedure

Participants enrolled in this institutional review board–approved study via an online research participation site where, following implicit consent, they completed the LSAS-SR (Baker et al., 2002), a 24-item self-report questionnaire that yields measures of how intensely people fear and how often they avoid social interaction and performance situations. The measure is appropriate to complete electronically (Hedman et al., 2010). Participants used a Likert-type scale to provide ratings of fear (0 = *none*, 1 = *mild*, 2 = *moderate*, 3 = *severe*) and avoidance (0 = *never*, 1 = *occasionally*, 2 = *often*, 3 = *usually*) for each item.

The LSAS-SR has demonstrated high internal consistency among people diagnosed with social phobia (α = .95) as well as among diagnosis-free adults (α = .94), and it shows strong convergent and discriminant validity (Fresco et al., 2001). Normative data for a sample of 175 patients diagnosed with social phobia yielded a mean fear score of 37.2 (SD = 12.9) and a mean avoidance score of 33.2 (SD = 14.4; Baker et al., 2002). Among college students (n = 2,914) drawn from the same population as the current sample, mean scores were lower than those obtained in clinical samples but still substantive (fear score: M = 19.8, SD = 12.3; avoidance score: M = 22.8, SD = 12.4; total score: M = 42.5, SD = 22.9; Tone, 2017). In the current study, both scales—fear and avoidance—showed excellent reliability and had a Cronbach alpha of .91.

Social anxiety score. Because the LSAS-SR Fear and Avoidance subscale scores were highly correlated (r = .76), we analyzed the total social anxiety score; its mean was 51 (SD = 23, range = 5–104). Severe social anxiety was well represented in our sample; more than half of the participants (n = 71; 58%) obtained total scores of at least 47, which Rytwinski and colleagues (2009) identified as the cut point that maximizes correct classification of individuals as nonanxious (low scores) or likely to meet criteria for SAD (high scores). Social anxiety scores did not differ significantly by age, gender, or their interaction (η^2 = .008, .013, .010; p = .33, .22, .29, respectively).

Prisoner's Dilemma game. Following completion of the LSAS-SR, participants were invited to enroll in the remainder of the study. Most (n = 106) came to a university research lab where they underwent consent procedures and then played three games of an iterated 23-trial version of the iPD game (Rilling et al., 2002). An additional 16 participants played three iPD games during a functional MRI scan; for these participants, each game comprised only 20 trials but did not otherwise differ from the version played in the lab.

Lab participants were scheduled in groups of three and, following consent, a researcher photographed them individually, introduced them to each other, and trained them as a group to play the iPD game. For each MRI participant, two confederates posed as research participants and were similarly photographed, introduced to the actual participant, and trained on the task. The researcher led participants, via a standardized script, to believe that they would be playing each of the three iPD games with a different coplayer. Two of the coplayers would be the other participants in their group; the remaining coplayer was a computer. We took this approach so that we could examine whether patterns of play and emotional response differed between games in which participants believed the other player was real and those in which participants were aware that they were playing a computer.

Before each game began, the name and picture of the putative human coplayer or the word *computer* and a picture of a computer appeared on the screen. In fact, the other player was always a computer. In accordance with ethical guidelines (Wendler & Miller, 2004), participants were informed at consent that during the study, they would receive misleading or inaccurate information. They were not told what it was or when this would occur. Participants were given the option of withdrawing from the study before participation if they preferred not to receive misleading or inaccurate information. No participants asked to withdraw.

After participants (and confederates, for the MRI study) completed training as a group, a research assistant took them to separate rooms in a university lab space or, for the MRI participants, to the scanner (MRI participants were told that the other players would be playing the game on remotely connected computers outside of the scanning room). They were not told whether they would meet again with the other participants in their group following play. Research assistants were instructed that if participants asked about this or other procedural details, they should tell them that no further information could be provided until after game play was complete.

Each participant then completed 10 practice rounds on a computer. Following practice, participants played three full games, two of which were ostensibly with each other. For each trial (see Fig. S1 in the Supplemental Material available online) within a game, participants first made a selection (*cooperate* or *defect*) via key press and then saw the other player's selection. Our interest was in each participant's response; consequently, we analyzed two-event sequences: the computer's selection for a given trial followed by the participant's selection for the next trial. Ideally, we would have analyzed 22 or 19 such sequences per game, depending on the number of trials, but for about 10% of the games, data were missing for some trials so that the mean number of sequences per game was 21.4 (range = 15–22).

Whereas participants made selections independently, the computerized coplayer cooperated or defected according to an algorithm based on human patterns of play (Rilling et al., 2002), which resulted in the computerized coplayer cooperating on about half the trials. After both players submitted their selections, the outcome of the round appeared on the screen, along with running totals of each player's cumulative earnings for that game. Participants were informed during training that they would be paid half the average of their earnings across all three games played.

After each of the three games, participants responded to 11 questions regarding their experience of both the game and the other player. An additional 4 questions were presented repeatedly throughout play (after every five trials) to increase reflection but were not analyzed further. After completing the third and final game, participants completed a paper-and-pencil questionnaire about their overall experience of playing the game.

Subsequently, a research assistant paid participants their winnings and debriefed each participant individually about the deception involved in the task and the motivation for its use. Debriefing was conducted in accordance with ethical guidelines for deception (Wendler & Miller, 2004). A research assistant read aloud a standardized statement that described the deception in the study and explained that deception was necessary to ensure that participants experienced the game as a "real" interaction with another person. Participants were also told that they would receive no further misinformation. After explaining the deception process and rationale, the research assistant asked participants whether they had been deceived and encouraged them to express concerns or thoughts that they had about the deception. No participants reported any distress or concern.

Game categories and scores. For purposes of analysis, we categorized games as the first one thought to be played with a human (H1), the second one thought to be played with a human (H2), and the game thought to be played with a computer (C). Coplayer order was determined randomly for each participant; 25%, 44%, and 30% of the participants thought that their coplayer was a computer for the first, second, and third games, respectively.

We derived two kinds of scores for each iPD game. The first was the percentage of the participant's responses that were *cooperate* (and so not *defect*). The second was a contingency index called a risk difference (Lloyd, Kennedy, & Yoder, 2013; for additional detail, see the Supplemental Material). This index provides a measure of participant responsiveness to the coplayer's previous selection. Positive risk-difference scores indicate that participants' responses were more concordant (cooperate after coplayer cooperation, defect after coplayer defection) than discordant (cooperate after coplayer defection, defect after coplayer cooperation), with higher scores indicating greater concordance. Negative scores indicate that participants' responses were more discordant than concordant. To make the scale similar to those for other variables, we multiplied risk-difference match scores by 100; thus, in theory, these scores could vary from −100 to +100.

Postgame ratings. Following each game, participants used a slider bar to complete 11 visual analog ratings (scaled 0–100) regarding perceptions of the game that had just concluded. The rating items focused on how positively participants felt toward the other player in the game that had just ended and on emotional experiences during the game (i.e., how stressed and how nervous they felt during play, how angry they felt toward the other player, and how happy they felt about how much they won). They also rated how important winning the game had been to them. For each item, the correlations between the three games (H1–H2, H1–C, H2–C, where H is a putative human coplayer and C is a computer) were all statistically significant. Consequently, for some subsequent analyses, we computed means for each item across the three games.

Debriefing and self-reported goals. After completing the three iPD games, participants answered a series of open-ended questions about their strategies of play, their experiences of the game when played with real people as opposed to the computer, their goal(s) during play, and their emotional responses to the games. Payment of earnings and debriefing about the deception used in the study followed participants' completion of this researcher-administered questionnaire.

Two independent observers coded each participant's self-reported goal(s) as *competitive* (emphasizing relative gain or winning more than the other player, e.g., "I wanted to win more than the other player"), *cooperative* (maximizing absolute gain for both players, e.g., "I wanted us both to earn money"), or *individualistic* (maximizing absolute personal gain, without attention to the other player's outcome, e.g., "I wanted to have fun"; "I wanted money for beer"); these goals align with categories of Prisoner's Dilemma game play motivation identified in prior research (Kuhlman & Marshello, 1975; Van Lange, De Bruin, Otten, & Joireman, 1997). Cohen's κ was .83, a value that suggests near 95% accuracy, given three codes (see Bakeman & Quera, 2011, Appendix A). Any coding disagreements were resolved by discussion between the observers.

Results

Descriptive statistics and preliminary analyses

Means and standard deviations for our variables are given in Table 1. As a preliminary matter, and to aid

Table 1. Descriptive Statistics and Gender by Age Analysis of Variance Results

			Gender		Age		G × A		*M*	
Variable	*M*	*SD*	η^2	*p*	η^2	*p*	η^2	*p*	Women	Men
Social anxiety	51	23	.016	.17	.005	.44	.010	.29		
Felt stressed during game	27	24	.016	.17	.005	.44	.010	.29		
Felt nervous during game	26	24	.005	.44	.000	.84	.002	.62		
Felt angry toward other during game	28	21	.035	.041	.001	.70	.006	.40	26	34
Felt positive toward other after game	58	21	.090	.001	.016	.17	.008	.35	62	49
Felt happy about amount won	69	23	.050	.014	.001	.79	.014	.202	72	62
Winning is important to me	55	27	.001	.68	.004	.51	.014	.20		
Confident could predict other's choices	60	17	.000	.99	.008	.34	.019	.14		
Felt other could predict my choices	59	17	.015	.18	.000	.95	.009	.29		
Based my choices on my predictions	70	19	.005	.45	.001	.76	.001	.78		
% I think other chose to cooperate	44	17	.000	.97	.000	.91	.001	.70		
% I think I chose to cooperate	40	20	.044	.021	.012	.23	.001	.71	37	46
% participant actually cooperated	38	15	.063	.006	.031	.053	.027	.075	35	43
RD matching score	26	24	.022	.11	.004	.51	.038	.033		

Note: $N = 122$. Means for each gender are shown when gender effects were statistically significant ($p < .05$). Before analysis, variable values were averaged over the three games (except for social anxiety, values for which were determined just once). Eta squares and *p* values are from a Gender × Age (G × A) analysis of variance. RD = risk difference.

later interpretation, we first asked whether these variables varied by participant gender or age. Gender significantly affected 5 of the 14 variables (see Table 1). Women felt less angry toward the other player during the game, more positive toward the other player after the game, and happier about the amount they had won than did men. Moreover, women thought they had chosen to cooperate less, and had actually cooperated less, than men. Still, both genders cooperated less (35% for women, 43% for men) than their coplayers, who by design cooperated 50% of the time. Age marginally affected only one variable (p = .053, controlling for gender); with each year of age, the percentage of cooperation increased about a point (b = 1.06%, p = .023).

Gender affected matching, but marginally. Although mean risk-difference match scores were positive, indicating more concordant than discordant responses, on average women tended to match less than men (24 vs. 31, p = .11). In fact, 17% of women and just 5% of men had negative risk-difference match scores, $\chi^2(1, N = 122) = 2.99$, p = .069 per Fisher exact test. Moreover, gender significantly modified the effect of age on the risk-difference match score; men, but not women, became less concordant with age (b = −3.11 vs. 0.56, p = .032 vs. p = .55).

Gender did not significantly affect reported goals during play: 39% endorsed competitive, 25% cooperative, and 36% individualistic goals, $\chi^2(2, N = 122) = 3.56$, p = .17. Gender did, however, moderate the effect of age on goals. The mean age of women endorsing a competitive goal was significantly less than that of men, 19.6 versus 23.0, $t(45) = 4.28$, $p < .001$, whereas the mean ages of women and men endorsing cooperative and individualistic goals did not differ significantly, 21.7 versus 20.1 and 21.0 versus 21.5, $t(29) = 1.28$ and $t(42) = 0.58$, p = .21 and .56.

Hypothesis 1: goals and social anxiety

The first hypothesis had two parts. First, to test whether greater social anxiety was associated with competitive goals, we conducted one-way analyses of variance (ANOVAs) with goal as the factor (competitive, cooperative, individualistic) and social anxiety as the dependent variable. For comparison, and as an exploratory matter, we conducted similar ANOVAs for the other variables (see Table 2). Second, to test whether greater social anxiety was associated with higher ratings of the importance of winning, we computed correlation coefficients, not just for this pair of variables but for all variables, again for comparison and as an exploratory matter (see Table 3).

As hypothesized, the mean social anxiety score was significantly higher for participants with competitive compared with cooperative goals, and higher—but not significantly so—when compared with those with individualistic goals (see Table 2). The η^2 = .068, an effect that Cohen (1988) labeled as small (.02–.13). Additionally, the mean rating for the importance of winning was significantly higher for participants with competitive

Table 2. Effect of Participants' Goals on Social Anxiety and Other Variables

	Goal				
Variable	Competitive	Cooperative	Individualistic	η^2	p
Social anxiety	58_a	45_b	47_{ab}	.068	.015
Felt stressed during game	31	24	24	.022	.26
Felt nervous during game	31	26	22	.025	.22
Felt angry toward other during game	30	26	29	.005	.74
Felt positive toward other after game	62	56	55	.021	.29
Felt happy about amount won	74	67	65	.037	.11
Winning is important to me	69_a	47_b	46_b	.164	< .001
Confident could predict other's choices	62	57	60	.012	.49
Felt other could predict my choices	61	55	59	.015	.40
Based my choices on my predictions	73	69	67	.021	.29
% I think other chose to cooperate	42	50	43	.045	.065
% I think I chose to cooperate	36_a	49_b	38_a	.074	.010
% participant actually cooperated	33_a	46_b	37_a	.133	< .001
RD matching score	15_a	45_b	25_a	.231	< .001

Note: N = 122: 47 with competitive goals, 31 with cooperative goals, and 44 with individualistic goals. Before analysis, variable values were averaged over the three games (except for social anxiety, values for which were determined just once). Eta squares and p values are from a goal, one-way analysis of variance. Means that do not differ significantly, $p < .05$, per a Tukey honestly significant difference test, share a common subscript. RD = risk difference.

Table 3. Correlations Between Social Anxiety and Other Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Social anxiety	—												
2. Felt stressed during game	.16												
3. Felt nervous during game	.25**	.83**											
4. Felt angry toward other during game	.19*	.62**	.48**										
5. Felt positive toward other after game	−.05	−.29**	−.13	−.61**									
6. Felt happy about amount won	.10	−.28**	−.18*	−.35**	.51**								
7. Winning is important to me	.22*	.29**	.26**	.31**	−.18*	.10							
8. Confident could predict other's choices	−.07	−.20*	−.18*	−.11	.20*	.34**	.10						
9. Felt other could predict my choices	−.02	−.01	.01	.05	.11	.14	.12	.43**					
10. Based my choices on my predictions	.06	−.09	−.05	−.08	.10	.23**	.23**	.40**	.19*				
11. % I think other chose to cooperate	−.06	−.05	.08	−.25**	.32**	.20*	−.22*	.09	−.27**	−.08			
12. % I think I chose to cooperate	−.20*	.03	.07	−.11	.12	−.13	−.22*	−.09	−.12	−.11	.60**		
13. % participant actually cooperated	−.19*	.05	.12	.02	−.04	−.12	−.17	−.13	−.14	.04	.41**	.59**	
14. RD matching score	−.20*	−.03	−.03	.06	−.21*	−.16	−.18*	.04	.11	.04	.02	.20*	.42**

Note: $N = 122$. RD = risk difference.
*$p < .05$. **$p < .01$.

compared with either cooperative or individualistic goals (η^2 = .16), whereas both the mean percentage of trials on which participants cooperated and the pooled risk-difference score were higher for participants with cooperative compared with either competitive or individualistic goals (η^2 = .13 and .23). Cohen called these medium effects (.13–.26). None of the effects in Table 2 were significantly moderated by either gender or age: For the Goal × Gender and Goal × Age interactions, median η^2 = .013 and .011 (range = .001–.042 and .002–.038), respectively, and median p = .48 and .53 (range = .082–.94 and .103–.88), respectively.

Again as hypothesized, higher social anxiety scores were significantly associated with higher ratings for the importance of winning (r = .24, p = .006; see Table 3), an effect in Cohen's (1988) small range (|.1–.3|). Neither gender nor age significantly moderated this effect; for the Importance of Winning × Gender and Importance of Winning × Age interactions, η^2 < .001, p = .72 and .71, respectively.

Hypothesis 2: social anxiety and feelings during and after the games

Our second hypothesis was that greater social anxiety would be associated with feeling more distressed during the game and less positive toward the coplayer after the game. Correlations for these and other variables are given in Table 3. As hypothesized, higher social anxiety was significantly associated with postgame reports of greater nervousness and greater anger toward the coplayer during play (r = .25 and .19, p = .005 and .034), both small effects. However, social anxiety was not significantly associated with feeling less positive toward the coplayer after the game had ended (r = –.05, p = .58).

Hypothesis 3: effects of social anxiety on play

Finally, we predicted that social anxiety would be associated with more frequent engagement in game behaviors that appear incompatible with a desire to keep or enhance social status. Specifically, we predicted that participants who endorsed higher levels of social anxiety would be more likely to show a pattern of discordant responding, in which they tended to cooperate following a coplayer defection, consistent with our earlier findings using this task. We also examined whether this pattern would differ when participants believed that they were playing with a real person as opposed to a computer.

Insofar as discordant responses—matching the coplayer's moves less frequently, which resulted in a lower risk-difference match score—were incompatible with a desire to keep or enhance social status, the negative correlation of social anxiety with the risk-difference match score pooled over the three games (r = –.20, p = .025) supported our hypothesis. Correlations between social anxiety and risk-difference match scores for separate games were still negative, but weaker, and did not indicate a stronger social anxiety effect when playing with a human: r = –.11, –.17, and –.10; p = .23, .062, and .27, for the H1, H2, and C games, respectively.

Examining the two possible discordant response types separately provided additional information. The correlation between social anxiety and the probability that participants would cooperate following coplayer defection—p(C|D)—pooled over the three games was near zero (r = –.01, p = .93), as were the correlations for the three games (r = –.05, .06, and –.11; p = .57, .52, and .23, for the H1, H2, and C games, respectively). This does not support our hypotheses that participants high in social anxiety would be more likely to cooperate following a coplayer defection. However, the correlation between social anxiety and the probability that participants would defect following coplayer cooperation—p(D|C)—pooled over the three games was significant (r = .24, p = .009), as were the correlations for the three games, at least marginally (r = .17, .16, and .22; p = .058, .080, and .017, for the H1, H2, and C games, respectively). Thus, only one of the two discordant responses included in the risk-difference match score correlated with social anxiety, and not the one we had predicted. Moreover, none of these correlations indicated that the effect of social anxiety was noticeably stronger or weaker when the coplayer was a human.

Differences when the coplayer was thought to be a computer

Nonetheless, as a descriptive matter, and to help guide future research, it makes sense to ask whether participants felt or played differently when they thought the coplayer was a computer rather than a human. Results of repeated measures ANOVAs—measures were for H1, H2, and C games—are given in Table 4. With the exception of two marginal effects concerning confidence in predicting the other's play and basing one's own play on those predictions (less when the coplayer was thought to be a computer), significant effects involved behavior, not feelings. Participants thought they had cooperated less, and actually had cooperated less, with the computer coplayer. As a result, they were less likely to match responses with the computer than with presumably human coplayers.

When the coplayer was thought to be a computer, the mean risk-difference match score was 14, significantly lower than the scores of 24 and 30 for the first

Table 4. Descriptive Statistics and Analysis of Variance Results by Putative Coplayer

	M			*SD*				
Variable	Person 1	Person 2	Computer	Person 1	Person 2	Computer	η^2	*p*
Felt stressed during game	27	27	27	27	27	27	.000	.96
Felt nervous during game	29	25	25	27	27	26	.027	.04
Felt angry toward other during game	29	27	30	25	25	26	.008	.36
Felt positive toward other after game	58	60	56	24	26	24	.011	.26
Felt happy about amount won	68	70	69	25	27	26	.006	.49
Winning is important to me	55	55	56	28	30	30	.001	.89
Confident could predict other's choices	61	63	57	25	25	24	.019	.098
Felt other could predict my choices	58	61	57	25	23	23	.009	.32
Based my choices on my predictions	70	72	67	24	24	23	.021	.074
% I think other chose to cooperate	44	45	43	21	24	20	.002	.75
% I think I chose to cooperate	45_a	40_{ab}	35_b	25	25	24	.068	< .001
% participant actually cooperated	42_a	40_a	32_b	19	20	18	.120	< .001
RD matching score	24_a	30_a	14_b	32	33	28	.096	< .001

Note: *N* = 122. Eta squares and *p* values are from a repeated measures analysis of variance. Measures were for first game played with a putative human coplayer, second game played with a putative human coplayer, and game played with a coplayer thought to be a computer. In fact, the coplayer was a computer for all three games. Means that do not differ significantly, $p < .05$, per a Tukey honestly significant difference test, share a common subscript. RD = risk difference.

and second games played, respectively, with the (presumed) human coplayers (see Table 4). Still, all three mean risk-difference match scores were positive, meaning that participants were more likely to make concordant than discordant responses. In fact, 73% of the participants' risk-difference match scores were positive for the H1 game, 83% for H2, and 70% for C. Thus, for a majority of participants, responses were more frequently concordant than discordant no matter the coplayer, just less strongly so when the coplayer was thought to be a computer. In contrast, 72% of the participants' risk-difference match scores were positive for the first game they played (regardless of coplayer), 74% for the second, and 76% for the third, remembering that which game the participant thought was the computer varied randomly.

Discussion

A widely cited evolutionary model of social anxiety (Gilbert, 2014; Trower & Gilbert, 1989) proposed that socially anxious behavior reflects a maladaptive reliance on phylogenetically old mechanisms that help to maintain peace within groups organized according to hierarchical status but that are less consistently useful in more egalitarian societies. We used iPD game data from 122 college students to test hypotheses based on three predictions from this model. Our findings align broadly with the predictions that Gilbert and colleagues put forward; they also suggest subtle ways in which the fit between the theoretical model and observed human behavior, cognition, and emotion could be refined.

Hypothesis 1: goals and social anxiety

The first hypothesis, that self-reported social anxiety, ascertained prior to game play, would be positively associated with self-reported competitive goals and ratings of the importance of winning, received support. As predicted, those who approached the game with competitive goals (e.g., "I wanted to beat the other player") had endorsed, on average, more social anxiety than had those who approached the game with cooperative goals (e.g., "I wanted us both to win money"). Social anxiety was slightly, but not significantly, higher among those with competitive goals than those with individualistic goals (e.g., "I just wanted money for beer"), as well. Moreover, high self-reported social anxiety related significantly, although weakly, to ratings of the importance of winning, regardless of whether participants thought they were playing a computer or a human.

It is notable that participants who generated competitive goals, and who also reported the highest mean levels of social anxiety, focused on outperforming or dominating dyadic partners. Trower and Gilbert (1989) proposed that this kind of competitive goal is a primary one for people with high levels of social anxiety, who perceive the world through an agonic lens. Typically, however, because they doubt their ability to achieve this type of goal, people high in social anxiety shift to safer goals, centered on avoiding humiliation or feelings of inferiority. It is thus surprising that, although social anxiety was associated with competitive goal setting, no participants who endorsed competitive goals indicated concern about avoiding loss or saving face. It is possible that participants with high social anxiety identified the iPD game context as low risk, given that outcomes were unlikely to influence future evaluations from the other players. If this was the case, those inclined to approach play in the agonic mode may have felt emboldened to set dominance-focused goals that might have felt too risky if the possibility of humiliation or shame had seemed high.

The subset of participants who set individualistic goals, which focused exclusively on personal gain without attention to the other player's outcomes, is interesting to consider in the context of Gilbert and colleagues' model. Members of this group appear to have approached play from an orientation that was neither agonic nor hedonic, in that they did not appear to acknowledge the other player as relevant to their goals at all. Notably, although their levels of interest in winning were comparable with those for the cooperative group, their rates of defection and noncontingent responding more closely resembled those of participants who set competitive goals. High levels of social anxiety did not characterize members of this group, making it unlikely that this variable was a salient driver for their iPD goals and behaviors. Their lack of overt interest in the other player, at least as a factor that might figure in desired outcomes, combined with their tendency to defect following cooperation, suggests that other interpersonal characteristics might be important to consider. In particular, this pattern seems reminiscent of the interpersonal coldness/dominance that predicted reduced giving in Rodebaugh and colleagues' iPD variant (Rodebaugh et al., 2016; Rodebaugh et al., 2017). Additional potentially relevant characteristics to consider include competitiveness, or the desire to win in interpersonal situations (Smither & Houston, 1992), and power motivation, or the desire to have an impact on other people (Winter, 1973).

Hypothesis 2: social anxiety and feelings during and after the games

Our second hypothesis was that social anxiety would be positively associated with distress during and after play. Our findings lent partial support to this prediction. Participants' self-evaluation following game completion of how nervous and angry they had felt during play was significantly and positively associated with social anxiety. Postgame feelings toward the coplayer, however, contrary to expectations and our prior findings using the iPD task (McClure et al., 2007; McClure-Tone et al., 2011), showed only a marginally significant negative association with social anxiety.

Although we found that social anxiety was associated with a predicted elevation of distress during the task, it is unclear whether and to what degree this distress was associated with low expectations of success in the face of opportunities to behave dominantly and, potentially, to win. Our data suggest that the distress that those with higher social anxiety endorsed was not a function of cumulating disappointment with or worry about earnings across the test session, given that social anxiety was not significantly associated with happiness about winnings. The absence of robust associations with postgame ratings of feelings toward other players further suggests that distress was not a function of beliefs that coplayers had treated them badly, as one might expect in people who experience paranoid anxiety and attribute ill intent to others (Matos, Pinto-Gouveia, & Gilbert, 2013). It is possible that the association between social anxiety and feelings of nervousness and anger during game play reflected a tendency toward negative self-evaluation and self-focused, or internal, shame, consistent with prior research on social anxiety (Gilbert & Miles, 2000). For example, participants with higher self-reported social anxiety may have experienced distress because they doubted that they could perform at a level that would not be humiliating.

Unfortunately, this possibility is impossible to examine with our data, because we did not explore participants' affect ratings in detail. In future iPD research, it would be useful to probe for elements of the inter- and intrapersonal contexts that evoke emotional responses during play in individual participants who vary according to social anxiety levels, as well as whether and how those responses evolve over the course of each game. There would also be value in examining the degree to which participants feel evaluated by research staff. In the present study, although researchers positioned themselves at a distance from participants during game play, it is possible that their presence evoked fears of evaluation for some of the more anxious young adults in the study, particularly during the one-on-one debriefing interview at the end of study participation.

Hypothesis 3: effects of social anxiety on play

Finally, we predicted that social anxiety would be associated with more frequent engagement in game behaviors that appear incompatible with a desire to keep or enhance social status, particularly cooperation following the other player's defection, which we considered to be a conciliatory or appeasing response. Results illustrated a complex pattern of play that varied among individuals along multiple dimensions, including goals, age, and gender. Across the sample as a whole, participants, particularly younger women, tended to defect more than cooperate. Defection and noncontingent responding were also particularly common among participants who endorsed competitive goals, consistent with prior research (Kuhlman & Marshello, 1975; Van Lange, 1999), and those whose goals were individualistic. Notably, however, participants were more likely to cooperate and to respond contingently when they believed they were playing real people than when they were playing the computer. The degree to which this pattern of play reflected concern about the other player's well-being, attenuated confidence during games with a computer about being able to anticipate the coplayer's actions, or other factors is unclear. Regardless, consistent with earlier studies (e.g., Sandoval, Brandstetter, Obaid, & Bartneck, 2016), this finding suggests that the belief that one's actions could harm or benefit a real person may influence iPD play in meaningful ways. Moreover, although there are both ethical and practical concerns associated with the use of deception (Kimmel, 2012), this finding suggests that its use may nonetheless be valuable in research that uses computerized coplayers.

Social anxiety, as expected, proved to be a salient variable. However, the observed associations between behavior and social anxiety did not conform precisely to our predictions. In particular, although social anxiety was associated with contingency, less anxious people were more contingent than were those who reported high levels of social anxiety. In other words, social anxiety was associated with more frequent failure to match others' choices. Further, social anxiety, rather than predicting more frequent cooperation following coplayer defection, was associated with a tendency to defect more often following coplayer cooperation.

These findings conflict with those from our earlier studies using the same iPD task, in which anxious/depressed youths engaged in more cooperative behavior in response to coplayer defection than did nondiagnosed peers (e.g., McClure et al., 2007; McClure-Tone et al., 2011). However, they align with research that has yielded evidence of a cold and withholding style, marked by failure to reciprocate positive social behaviors, among some individuals with high social anxiety during economic exchange games (e.g., Rodebaugh et al., 2016; Rodebaugh et al., 2011; Rodebaugh et al., 2013; Rodebaugh et al., 2017). Thus, rather than predicting an atypical pattern of responding to others' negative behaviors with putative bids for conciliation, social anxiety appeared, in this sample, to predict a tendency to respond atypically—and aversively—to positive behavior from others.

What the decision to defect following cooperation means, however, is unclear. On the one hand, it could indeed reflect a cold unwillingness to reciprocate positive overtures, consistent with that observed, at least among participants with a vindictive style, in Rodebaugh and colleagues' (Rodebaugh et al., 2016; Rodebaugh et al., 2017) studies. On the other hand, it could reflect a self-protective pattern of response, rooted in failure to trust that others' positive gestures are reliable and fear that one will be "duped" or suckered in to showing vulnerability that others could then exploit. As Vohs, Baumeister, and Chin (2007) cogently argued, the experience of being duped elicits powerful emotional responses and may drive a more cautious approach in future contexts in which trust might be violated. For those with social anxiety, who exhibit a heightened proneness to self-blame and expectations that others will evaluate them as foolish or gullible, fear of being duped may be especially strong and may lead to inappropriately conservative responses to others' overtures, particularly in the absence of access to nonverbal cues that might signal trustworthiness (DeSteno et al., 2012). The fact that both participants who set competitive goals (who were also, on average, higher in social anxiety) and those who set individualistic goals showed this pattern of play points to the presence of multiple paths to the same choices during iPD games that warrant research attention.

Potential moderating variables

Taken together, the findings from the present and earlier studies underscore the value of identifying variables that could modulate patterns of affect and behavior associated with social anxiety and with other interpersonal variables during repeated competitive interpersonal interactions. Candidate variables include demographic characteristics, such as gender and age. They also encompass a range of personality features, some of which have already been found to relate independently to response selection during both iPD and one-shot Prisoner's Dilemma games (Boone, De Brabander, & van Witteloostuijn, 1999; Rodebaugh et al., 2016; Rodebaugh et al., 2017).

We first consider gender. Although this variable related to general cooperation and goal selection in our study, it did not interact with social anxiety to predict thoughts, emotions, or patterns of play during iPD games. Unexpectedly, young women in our sample were less cooperative and more competitive than male peers; this finding conflicts with popular stereotypes (Niederle & Vesterlund, 2011) as well as recent meta-analytic evidence that cooperation during social dilemma tasks does not differ, overall, between men and women (Balliet, Li, Macfarlan, & Van Vugt, 2011). It makes sense, however, in light of evidence from the same meta-analysis that women tend to cooperate less than men do when their coplayers during social dilemma games are of their own gender. Nearly 70% of our participants were women; thus, participants were paired more often with women than they were with men. Unfortunately, we did not document dyad characteristics, which might have allowed us to examine this possibility more closely and to test whether gender might interact with social anxiety to predict outcomes, in particular in dyadic contexts. In future research, attention to dyadic, as well as individual, characteristics may help clarify the circumstances that foster or prevent agonic behaviors.

Second, although the present findings suggest negligible effects of age as a moderator within our young adult sample, they differ in notable ways from the results of our iPD studies with anxious/depressed and diagnosis-free adolescents (McClure et al., 2007; McClure-Tone et al., 2011). This suggests that examination of developmental variables as potential moderators of associations between social anxiety and patterns of feeling, thought, and behavior in competitive social situations may be important. Like adults with high social anxiety, children and adolescents who fear evaluation from others are hyper-attuned to potential threats in their social environments; however, their response repertoires may differ, at least in part as a function of cognitive and emotional developmental status.

Third, we treated social anxiety as an isolated psychological dimension in the present study; in reality, social anxiety interacts with multiple other dimensionally distributed emotional, cognitive, and personality characteristics to shape behavior. Rodebaugh and colleagues have demonstrated, for example, that social anxiety and vindictiveness can combine to affect patterns of iPD play. It would also be valuable to study whether other personality variables that have been identified as relevant to behavior during iPD tasks—these include locus of control, self-monitoring, and sensation seeking (Boone et al., 1999)—may similarly interact with social anxiety to modulate goals, feelings, and response choices in competitive contexts.

It will also be important to test the specificity of associations between social anxiety and goals, emotional responses, and behavioral choices in tasks like the iPD game used here. It is possible, for example, that broad variables such as trait anxiety or negative emotionality could better account for the findings reported here than social anxiety per se. Because we did not gather data regarding either of these variables, we were unable to test this possibility. However, because social anxiety scores were not significantly associated with several measures that should presumably tap negative emotionality—low happiness with winnings, feelings of stress during game play, or negative feelings about the coplayer after the game—we hold that the observed associations could be specific to social anxiety. Empirical tests of this assertion, however, are needed, and use of observer or informant reports regarding participant social anxiety and other characteristics, which have already been used in some studies (e.g., Rodebaugh et al., 2017), would address some of the issues introduced by reliance on self-report alone.

Limitations and future directions

The present line of research could be enhanced and extended by attention to several questions that were beyond the scope of our study. First, research using ecological momentary assessment to track real-life interactions has demonstrated that anxious individuals show more variable behavior across time and across different settings than do less anxious peers (e.g., (Rappaport, Moskowitz, & D'Antono, 2014). Although we focused in our analyses on immediate contingent and noncontingent responses to others' behavior, the iPD game lends itself to complex analyses of patterns of change over time—both within and across games—that could provide more precise insight into behavior patterns associated with social anxiety. In particular, such an approach to iPD data might help us better understand how social anxiety relates to an individual's adaptation to another player's cumulative pattern of responding over time, as well as how shifting levels of distress and comfort across a game or game series might correspond with behavioral responses. Moreover, this approach would permit examination of direct communication between players on a round-by-round basis about their perceptions of each other's play, which could improve elicitation of social anxiety in the moment. This kind of research, in turn, has potential to inform evolutionary models of social anxiety in novel ways by characterizing how the consistency between behavior and model predictions varies across time and context.

Asking multiple times during play about goals and emotional responses would also permit examination of dynamic interplay among motivations, feelings, and strategies. Our approach of asking for retrospective reports after each game precluded us from capturing changes in goals and emotions that might have followed particularly reinforcing or punitive interactions. Moreover, although we attempted to minimize the risk that we would bias participants' responses by asking an open-ended question about goals, we could have obtained a richer and potentially more informative set of data had we also followed up with probes regarding rationales for each goal and evaluations of whether participants had met their goals.

Another important question to consider in future research is whether and how individuals' real-life social status, as well as how stable they perceive that status to be, influences their interpersonal goals and behaviors. Research in NHPs suggests that those in unstable hierarchies, particularly if they occupy high or low positions, may be particularly vulnerable to stress (Sapolsky, 2005) and may thus be prone to respond to the environment in a negatively biased and maladaptive way. We lacked data regarding the social experiences of our participants outside of the study context; future work would be enhanced by detailed characterization of participants and both their real and perceived social settings. In addition, there would be utility in adapting the present study design to introduce social comparison; for example, participants might be told that the other players in their group are either more likely or less likely to win at the task than they are, on the basis of questionnaire responses. Patterns of play with "superior" versus "inferior" coplayers could then be examined separately.

Finally, although a sizable proportion of our sample endorsed high levels of social anxiety, the degree to which our findings generalize to individuals with diagnosed SAD is unclear. The model of social anxiety on which we based hypotheses, however, focuses on the putative evolutionary roots of socially anxious patterns of behavior, regardless of whether they cross categorical thresholds of severity or pervasiveness. Further, Rodebaugh et al.'s (2016) findings suggest that a dimensional approach may be particularly useful when examining associations between social anxiety and social behavior during economic exchange tasks.

Conclusion

Our findings, taken as a whole, suggest that even in complex social groups in which hedonic, rather than agonic, strategies are normative and adaptive, a bias to approach the social environment via the agonic mode is associated with social anxiety. Not only was social anxiety associated with a tendency to set competitive goals, but it also predicted distress during efforts to achieve these goals. It also related to a tendency, particularly among women, to enact competitive behaviors from a stance that prioritizes one's own success over that of others. These findings broadly align with Gilbert and colleagues' (Gilbert, 2014; Trower & Gilbert, 1989) evolutionary model of social anxiety. However, we did not find evidence of an expected pattern of appeasing behavior among participants who had endorsed high social anxiety. Instead, their behavior fit a pattern that could reflect, among other things, interpersonal coldness or a self-protective avoidance of possible exploitation. Clarifying how social anxiety may interact with other characteristics, including gender, age, and personality traits, to influence social behavior, as well as close examination of the dynamic flow of thoughts, feelings, and behaviors of those who experience high levels of social anxiety as it changes over the course of development, may help develop further nuances of Gilbert and colleagues' influential evolutionary model.

Action Editor

Scott O. Lilienfeld served as action editor for this article.

Author Contributions

E. B. Tone and E. Nahmias developed the study concept. E. B. Tone, E. Nahmias, N. Fani, T. Kvaran, and E. A. Schroth contributed to the study design. Testing and data collection were performed by E. B. Tone, E. Nahmias, N. Fani, T. Kvaran, and E. A. Schroth, with the support of research assistants. R. Bakeman and E. B. Tone performed the data analysis and interpretation, with input from E. Nahmias, S. F. Brosnan, and T. Kvaran. E. B. Tone drafted the manuscript, and E. Nahmias, S. F. Brosnan, N. Fani, T. Kvaran, and R. Bakeman provided critical revisions. All the authors approved the final manuscript for submission.

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Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

Supplemental Material

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