Measuring Social Anxiety Related Interpersonal Constraint with the Flexible Iterated Prisoner's

Dilemma

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Abstract

Data from self-report and observational studies make it clear that problematic social anxiety confers interpersonal constraint that may contribute to the interpersonal dysfunction reported by individuals with social anxiety disorder. Direct observation of interpersonal behavior in established relationships is rare and difficult to obtain for practical reasons. We tested a flexible iterated prisoner's dilemma computer task to examine whether it might capture interpersonal constraint related to social anxiety. Our first study suggested that, at least for men, the task directly captures social anxiety's constraint on responses to friendly giving. Our second study more strongly supported the assertion that the task directly assesses interpersonal constraint. The data support a model in which social anxiety directly confers trait-like tendencies toward interpersonal constraint and indirectly constrains behavior in specific interactions. These studies provide further evidence that constrained responses to positive social behaviors are characteristic of people with problematic social anxiety and may be particularly important to dysfunctions in the close relationships of these individuals.

Key words: Social anxiety disorder; interpersonal processes; prisoner's dilemma; social dilemma; friendship

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1. Introduction

1.1. Social Anxiety and Friendship Impairment

Multiple studies have established that problematic social anxiety is associated with self-reported impairment in interpersonal relationships in general (Ruscio et al., 2008; Schneier et al., 1994; Torgrud et al., 2004). More specifically, in two large epidemiological datasets, social anxiety disorder was associated with perceived friendship impairment, above and beyond a variety of other mental disorders and demographic characteristics (Rodebaugh, 2009). In fact, Rodebaugh (2009) found that, of the mental disorders available in the datasets, *only* social anxiety disorder showed such a relationship with perceived friendship impairment, indicating that social anxiety disorder may have a special relationship with friendship impairment. However, the mere existence of this impairment tells us little about the nature of the impairment.

1.2. Social Anxiety and Interpersonal Behavior

Clues to how social anxiety disorder could confer impairment in friendships and other close relationships can be drawn from the available research regarding social anxiety and interpersonal behavior. When people with social anxiety disorder or higher social anxiety are observed in interactions with confederates, their behavior typically displays constraint that involves fewer affiliative behaviors as well as fewer assertive behaviors. For example, in one study, instead of displaying *more* submissive behavior and *more* avoidance behavior per se in comparison to normal control participants, those participants with social anxiety disorder displayed *less* dominant behavior as well as *less* cooperative behavior in an interaction (Walters & Hope, 1998). Similarly, a study combining self and peer ratings of interpersonal problems found that avoidant personality disorder traits were most strongly related to problems with lack of assertion and problems with lack of warmth (Rodebaugh, Gianoli, Turkheimer, & Oltmanns, 2010). The latter class of problems included not only difficulty in feeling close to people, but also

difficulty with such affiliative behaviors as giving gifts and opening up to people. The name given to this class of problems varies by study, typically in relation to specific instruments or theories, but it seems to us that affiliation, mutual openness, feelings of warmth, and cooperative behavior are related and required for increasing intimacy and strength of friendship. We will refer to this constellation of behavior and affect as *positive reciprocity.*

Findings regarding lack of assertion among people with higher social anxiety are entirely consistent with the emphasis in prominent cognitive behavioral models on safety behaviors and both subtle and overt behavioral avoidance designed to avoid negative evaluation (Clark & Wells, 1995; Heimberg, Brozovich, & Rapee, in press; Rapee & Heimberg, 1997). Lack of positive reciprocity may appear to be a more surprising finding. It might seem that moderate or even excessive positive reciprocity would be more adaptive for avoiding negative evaluation. Nevertheless, constrained positive reciprocity has also been observed in multiple studies, the most persuasive of which is arguably that of Meleshko and Alden (1993).

Meleshko and Alden (1993) examined the amount of reciprocation of intimacy evidenced by people higher vs. lower in social anxiety in two conditions: (a) a low-intimacy condition, in which a confederate revealed relatively little, and (b) a high-intimacy condition, in which the confederate revealed progressively more across the interaction task. Whereas people with lower social anxiety reciprocated the escalating intimacy, responding with more self-revelation when the confederate did so, people with higher social anxiety disclosed at a moderate rate in both conditions. Alden and Taylor (2004) propose that such constraint is a self-protective strategy to avoid certain types of interpersonal outcomes (e.g., rejection). Although increasing positive reciprocity might lead to increasing closeness to another person, it would also trigger greater attention, and recent conceptualizations of problematic social anxiety suggest that people with higher social anxiety tend to avoid evaluation in general, not simply overtly negative evaluation (Heimberg et al., in press).

Tentative evidence based on peer report suggests that socially anxious individuals may display a similar pattern of interpersonal constraint not only when interacting with confederates, but also when interacting with peers who likely include friends (e.g., Clifton, Turkheimer, & Oltmanns, 2004; Rodebaugh et al., 2010). However, to the best of our knowledge, there are no studies published that clearly focus on social anxiety and friendship and include measures beyond self-report. Fernandez and Rodebaugh (2010) focused on self-report regarding friendship and demonstrated in a series of three studies that higher social anxiety among undergraduates was associated with a constellation of self-reported reactions to favors from friends. Across three studies, Fernandez and Rodebaugh found that people with higher social anxiety were most likely to report negative emotions such as awkwardness and guilt in response to favors. This negative constellation of reactions was in turn related to (a) more concerns about the friend's expectations and (b) less report of positive reactions. Further, the relationship between social anxiety and friendship quality in their Study 3 was partially mediated by the self-reported negative and positive reactions to favors. Thus, initial self-report findings support the notion that social anxiety impairs friendship through mechanisms similar to those previously uncovered in more general studies of interpersonal behavior (i.e., lack of positive reciprocity). However, full explication of the ways that social anxiety impairs friendship or any other kind of close interpersonal relationship requires further research.

1.3. Difficulties Inherent in Directly Observing Friendships

Only direct observation of interpersonal behavior in friendships would conclusively settle the issue of whether the same interpersonal behavior found to affect other interactions also takes a toll on the friendships of people with higher social anxiety. No such study appears to be available, and only two such published studies are available regarding intimate relationships (Beck, Davila, Farrow, & Grant, 2006; Wenzel, 2002). It seems likely that the lack of studies is due to both methodological concerns and pragmatic issues. First, established relationships do not allow the experimental control afforded by confederates, who can be trained to offer nearly

the same range of reactions to each participant. At first blush, it seems impossible to obtain

similar control in a study of existing relationships. Second, obtaining data from a primary

participant and a friend is at least twice as difficult and expensive as obtaining data from either a

single person or a participant and a confederate. We propose that the study of interpersonal

behavior and social anxiety can take a cue from social psychological and social neuroscience

approaches, and use a simulation of a friendship interaction to take a step closer to direct

observation of friendships.

1.4. The Prisoners' (or Social) Dilemma as a Simulation of Interpersonal Interaction

The prisoners' dilemma (PD), sometimes also referred to as a (type of) social dilemma,

is a behavioral economic game involving the exchange of tokens between players that has been

used extensively as a simulation of interpersonal interactions across disciplines (e.g., Bendor,

Kramer, & Stout, 1991; Majolo et al., 2006; Tazelaar, Van Lange, & Ouwerkerk, 2004; Van

Lange, Ouwerkerk, & Tazelaar, 2002). In this game, each player must make a choice regarding

whether to cooperate with or defect against the other player. Cooperation is defined as acting in

the mutual best interest, whereas defection is defined as acting in one's own short-term self-

interest. The outcomes of different decisions on the PD define the difference between

cooperation and defection by making it *mutually* beneficial when both players cooperate,

mutually detrimental when both players defect, yet the most *personally* beneficial when one

player defects despite the fact that the other person cooperates. Thus, as pointed out by

Axelrod and Hamilton (1981), the game provides the same temptation to cheat or act against

others that can occur when a person or group faces a similarly self-interested entity, but also

provides the same promise of potential rewards for cooperation.

Although the simplest version of the game involves a single interaction, it is clear that

most interpersonal interactions of interest involve repeated interaction. In the iterated PD, the

same participants play repeatedly. The game is of interest because it is assumed that iterated

PD strategies (rules for employing cooperation and defection) correspond to real-life

interpersonal strategies. For example, the well-known Tit for Tat (TFT) strategy uses *strict reciprocity*: reciprocity based only on recent behavior (e.g., defection for defection) (Axelrod & Hamilton, 1981). An analogous interpersonal exchange is assertively complaining when one is slighted, matching defection for defection. Another example is immediately giving a compliment after receiving one, matching affiliation with affiliation. Most theories of *friendship* (Silk, 2002; Tooby & Cosmides, 1996) define it as cooperative beyond the bounds of strict reciprocity. For example, continuing to be pleasant to someone who is usually helpful, but is understandably having a bad day, is friendly cooperation that exceeds strict reciprocity.

One of the obvious challenges to even the iterated PD as an interpersonal simulation is its external validity. Two additions to the game arguably help to improve its external validity. First, the dichotomous options of cooperate vs. defect can be expanded to a range of cooperation vs. defection. This addition leads to a game that we will refer to as the *flexible iterated PD* (FIPD). Second, random error can be introduced, simulating the communication errors common to interpersonal exchanges; multiple studies have demonstrated that the addition of such error, when players are aware that it can occur, improves the degree to which players cooperate, more closely simulating actual interpersonal behavior, which is often more cooperative than PD games might otherwise suggest (Tazelaar et al., 2004; Van Lange et al., 2002). An FIPD that includes random error thus provides a potentially externally valid task that: (a) can be run in simulation by computer (without the participation of an actual friend) and (b) can provide strong experimental control by limiting the computer's behavior to a pre-set algorithm or set series of responses.

1.5. The Current Studies: Effects of Social Anxiety in the FIPD

In summary, available evidence suggests that social anxiety should produce constrained positive reciprocity and assertive behavior in interpersonal interactions, and these patterns may generalize to friendships. In the FIPD, constrained positive reciprocity would consist of lower cooperation when the other player cooperates, whereas lower assertion would involve

continued cooperation despite defection on the part of the other player. We tested both of these

hypotheses across two studies, although we focused primarily on the hypothesis regarding

constrained positive reciprocity. In each study, a group of undergraduate participants completed

one or more measures of social anxiety and then completed the FIPD. In conducting these

studies, we had two goals. The first was to test the proposition that social anxiety constrains

interpersonal behavior in friendships using a method that went beyond self-report alone without

sacrificing precise control. The second was to test whether the FIPD might be useful in

assessing the interpersonal behavior that mediates the relationship between social anxiety and

friendship impairment.

2. Study 1: Affiliation and Assertion

2.1. Participants

A total of 74 undergraduate participants participated in this study for partial completion of

credit or extra-credit in a psychology course. There were about the same number of women (n =

39, 53%) as men, and the average age was 19.22 (SD = 1.01). Most participants were white (n

= 47, 64%); other participants were Asian or Asian American (n = 19, 26%), Black (n = 2, 3%),

Hispanic (n = 4, 5%), and multiracial (n = 2, 3%). Notably, 15 of these participants met a cut-off

indicating probable social anxiety disorder based on the Social Interaction Anxiety Scale (Brown

et al., 1997).

2.2. Measures

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) is a 20-item measure

employing a 0 (*Not at all*) to 4 (*Extremely*) Likert-type scale. The items describe anxiety-related

reactions to a variety of social situations (e.g., *I am tense if I am alone with more than one

person*). Overall, research on the scale suggests good to excellent reliability and good construct

and convergent validity (see Heimberg & Turk, 2002, for a review). Available evidence suggests

that the reverse-scored items fail to load on the same factor as the other items (Rodebaugh,

Woods, Heimberg, Liebowitz, & Schneier, 2006) and appear less related to social anxiety and

more related to extraversion than is desirable (Rodebaugh, Woods, & Heimberg, 2007). In the current study, the SIAS displayed very good internal consistency for both the straightforward (i.e., total of items without the reverse-scored items) and original total (αs > .93). The straightforward total (S-SIAS) was used for analyses.

2.3. Apparatus

The FIPD program was written in VB.NET by the third author. On each turn of the game, participants were asked to divide 10 tokens between their computerized partner and themselves. Decisions were made simultaneously on each turn, and participants were given 15 seconds to make a decision before they were asked to submit their decision. Participants were then asked to indicate how they expected their partner to act. Feedback screens, which included information about tokens given, tokens kept, points resulting from given and kept tokens, and points in total were displayed for 30 seconds maximum, and during decisions participants were given a history feedback screen which displayed the results of the trial immediately previous to the current trial (how many tokens they had given and kept and how many tokens the other player had given and kept). Tokens given to the other player were worth 2 points *to each player* and tokens kept were worth 3 points to the individual player only. Thus, if both players cooperated maximally (i.e., both shared 10 tokens), each player would earn 40 points. If each player kept all 10 tokens, both players would earn 30 points. However, if one player cooperated maximally and the other defected, the cooperating player would receive only 20 points, whereas the defecting player would earn 50 points (the maximum possible on any single turn). Intermediate allocations (e.g., keeping 5 tokens and sharing 5) would produce intermediate payoffs. Thus, the payoff matrix entailed a tension between the desire to exploit one's partner and maximize earnings in the short term, and cooperate with one's partner and maximize earnings over the long term (due to the expectation of reciprocal cooperation).

Each participant played 40 rounds with a computer partner. To make the interaction more realistic, participants' choices were affected by noise on 10% of trials causing anywhere

between a 3 token decrease to a 3 token increase in intended donation, with the restriction that this change in donation could not produce allocation values outside the normal bounds of 0 to 10 tokens. Noise was not added to the computer's decisions because the predetermined defections (see below) already induced considerable deviation from the strategy's expected behavior.

To allow a test of constraint of both affiliative and assertive behavior, we formulated a strategy that we referred to as Fickle Friend (FF). This strategy was designed to initially act in a friendly way, and later fail to act cooperatively without provocation, thus providing us with two situations (friendly and unfriendly partner behavior) with which to assess constraint. The strategy began by giving 5 tokens (the same amount was used by Van Lange et al., 2002) and then proceeded with the Raise the Stakes strategy defined by (Roberts & Sherratt, 1998). When a participant matched the amount the computer gave on the immediately previous turn, the strategy dictated that the computer give 1 token more than the participant's previous donation (e.g., to elicit more cooperation). If the participant exceeded its cooperation, it increased giving by 2 tokens over the participant's previous turn. When a participant undercut the strategy in the previous turn, it defaulted to strict reciprocation of the participant's previous donation. To assess degree of assertiveness in response to defection, the strategy also gave 0 tokens on seven trials: 11, 19, 24, 27, 29, 34, and 38.[1] These trials were pseudo-randomly generated such that the defections would occur in 20% of the total trials, but not within the first ten trials, concurrently, or every-other turn across six or more turns. These constraints were adopted to (a) make it possible for cooperation to be established (in the first ten trials) and (b) discourage participant attempts to predict the defections on the basis of apparent patterns. In addition, we expected that multiple defections in a row would be perceived as clearly hostile and would possibly cause floor effects by leading most participants to abandon cooperating.

Variables derived from the FIPD. Intended giving (ignoring any error generated for that turn) across the first 10 trials was totaled and interpreted as a measure of positive reciprocity.

Intended responses on the turns following computer defections were also totaled. When variance due to initial giving is accounted for, giving on turns following defections can be interpreted as a measure of assertive behavior, with lower scores indicating greater assertion. Both of these composites showed good internal consistency (αs > .76).

2.4. Procedure

Participants gave informed consent and were given an opportunity to ask questions of the experimenter. They were given a packet containing demographic questions, the SIAS and other measures not used here. The experimenter explained the overall FIPD, which was referred to as "the social dilemma game" to minimize participant recognition that this was a variety of the PD game. It was explained that the goal of the game was to maximize one's earnings while imagining one was playing a friend. The experimenter used the word "friend" in every reference to the computerized partner to help the participant conceive of the partner as a friend. Participants were told that communication error would occasionally occur in the experiment, meaning that the amount they or the computer partner would get was not the amount that was actually pledged. Further, participants were told that they would be informed when error affected their play, but not when it affected their partner's. Participants thus could not be certain whether the defections in the game were due to random error or were a part of the computer's strategy.

Each participant played 40 rounds with the FF strategy described above without being given any information about the strategy the computer was playing (or, indeed, even any confirmation that the computer used a strategy). Participants were fully debriefed at the end of their participation.

2.5. Data Analytic Strategy

We used multiple regression to test the hypotheses that social anxiety would be related to giving behavior during the task such that higher social anxiety would predict constrained (i.e., less) giving at the beginning of the task and constrained response to defection after the

computer strategy defected (e.g., more giving after the computer defected). Because gender

differences in friendship have been postulated to extend throughout the lifespan (Maccoby,

1990) and some differences regarding power dynamics have been observed into at least late

adolescence (De Goede, Branje, & Meeus, 2009), gender was included in each analysis and

interactions with gender were evaluated. Casewise diagnostics were also examined throughout

to determine whether individual cases had an undue influence on the regression line. The

statistic SDBETA was used to detect undue influence (Neter, Wasserman, & Kutner, 1989).

When SDBETA exceeded 1 for a case, it was deleted and the analyses rerun. Such deletions

are noted below.

3. Results and Discussion

3.1. Overall Task Behavior

Participant giving across the 40 turns is displayed in Figure 1. These data indicate that

participants initially increased their investment on each turn. Indeed, participants gave more at

turn 10 than turn 1 ($t[73] = 5.79$, $p < .001$). Also evident from these data is a tendency for

participants to give less after the computer defected; this tendency was particularly strong for

the first defection; participants gave significantly less on turn 12, after a defection, then they did

on the previous turn ($t[73] = 6.29$, $p < .001$). Participant giving on turn 12 was equivalent to their

giving on turn 1 ($t[73] = 0.23$, $p = .820$).

3.2. Prediction of Initial Giving

Social anxiety, gender, and their interaction were entered in a multiple regression to

predict giving across the first 10 turns. The interaction between gender and social interaction

anxiety was statistically significant (part $r = -.29$, $p = .014$). The effect of social anxiety was

therefore investigated separately in each gender. Among men, the hypothesis that social

anxiety would constrain giving was supported; social anxiety was inversely related to giving

across the first ten turns ($r = -.39$, $p = .020$). In contrast, the hypothesis was not supported

among women, who displayed no significant relationship between social anxiety and giving ($r =$ .20, $p =$ .200).Overall, men and women did not differ in initial giving ($t[72] = 0.26$, $p =$ .796).

3.3. Prediction of Response to Defection

A multiple regression was used to predict giving on the turns after defections using giving on the first 10 turns, social anxiety, gender, and the interaction between social anxiety and gender. Giving on the first 10 turns was included to ensure that giving on the turns after defection represented response to defection more than overall tendency to give. Giving on the first 10 turns was the only statistically significant predictor (part $r =$ .49, $p <$ .001), but the interaction between gender and social interaction anxiety approached significance (part $r =$ .18, $p =$ .075). The effects of social anxiety were therefore investigated in each gender for exploratory purposes. Among men, the hypothesis that social anxiety would constrain reaction to defection was supported by a correlation indicating that men with higher social anxiety were likely to give more after defections once baseline giving behavior was accounted for (part $r =$ .34, $p =$ .038). Among women, no such relationship was found (part $r =$ -.03, $p =$ .810). Overall, men and women did not differ in behavior after defection, whether initial giving was first accounted for or not (ps > .20).

4. Study 1: Conclusion

This study represents an initial attempt to use the FIPD to sample interpersonal constraint related to social anxiety. Participants clearly changed their behavior based on the computer's current behavior, increasing cooperation over the course of the first 10 turns and then reacting to the computer's repeated defections by decreasing cooperation. Further, there was some evidence of effects for social anxiety on task behavior, although these effects were moderated by gender. Thus, feasibility of using the task to detect interpersonal effects is supported. It should be noted that the moderation by gender was unexpected. Plausibly, men might be more vulnerable to the effects of social anxiety on friendship due to the fact that their friendships might still be more sensitive to power differentials than the friendships of women (De

Goede, Branje, & Meeus, 2009). However, this explanation of the effect is clearly speculative, and we see no firmer explanation offered by research regarding gender differences in social anxiety in particular. We therefore believed it was important to test whether the moderation effect could be replicated before firmly postulating a mechanism to account for it.

Study 1 suggests that the FIPD may have value in assessing interpersonal constraint related to social anxiety. However, Study 1 also had a number of limitations. First, following the theory that it is negative reactions to positive events that most strongly link social anxiety to impaired friendships (Fernandez & Rodebaugh, 2010), it may be important for the computer to be very clearly reacting in a positive and friendly way. It might be that increasing the friendliness of the strategy across more turns would better allow detection of the effect. Second, it is important to note that our underlying model is actually a mediation model. In the model, social anxiety tends to confer certain tendencies toward interpersonal constraint that, in turn, impair relationships. This means that the strongest correlations with constrained giving on the friend version of the FIPD should be with tendencies toward interpersonal constraint (that is, with the mediating variable), not social anxiety itself. In Study 1, we tested the more distal effect between trait social anxiety and behavior, whereas the relationship between the mediator and behavior should be more reliably detected. Thus, to determine whether the FIPD task shows promise as an assessment in problematic social anxiety, it may be more important to determine that it shows relationships with self-reported tendencies toward interpersonal constraint rather than with social anxiety per se.

Third, the design in Study 1 did not allow us to assess the degree to which the experimental task instructions successfully shaped participants' perceptions and behavior. That is, did participants genuinely view the computer partner as a friend and behave accordingly? The ecological validity of the FIPD as a model of interpersonal interaction depends on the assumption that participants' behavior is sensitive to such instructions. Previous studies involving randomly-paired dyads of human participants have shown that players are more

cooperative when playing with a friend than when playing with a stranger (Majolo et al., 2006); we predicted that a similar effect should hold for the FIPD even in the absence of a human partner. Moreover, participant perception of the computer's behavior should track the instructional set: the computer player should be perceived as more friendly and instigate less negative affect (e.g., frustration) when viewed as a friend rather than a stranger or computer.

Study 2 was designed to address all three of these limitations. To encourage participants to view the computer as a friend, we employed an unambiguously friendly strategy that did not defect on multiple trials. To directly test the proposed mediation model, we explicitly measured the trait-like tendency toward interpersonal constraint, in the form of negative reactions to favors. Finally, to evaluate the ability of the FIPD to capture friend-like interactions as distinct from other types of interpersonal interaction, different groups of participants were assigned to perform the task as if playing with a friend, stranger, and computer. We expected to find direct effects of interpersonal constraint in response to friendly favors on task behavior, as well as indirect effects of social anxiety through this proposed mediating variable. We further hypothesized that interpersonal constraint should lead to constrained giving only in the condition in which participants were asked to play as if playing with a friend (not a stranger or a computer).

5. Study 2: FIPD with Different Players

5.1. Participants

A total of 141 undergraduate participants participated in this study for partial completion of credit or extra credit in a psychology course. Most were women (n = 98, 70%) and the average age was 19.48 (SD = 1.19). Most participants were white (n = 98, 70%); other participants were Asian or Asian American (n = 27, 19%), Black (n = 8, 6%), Hispanic (n = 5, 4%), and multiracial (n = 3, 2%). Notably, 35 of these participants met a cut-off indicating probable social anxiety disorder based on the Social Interaction Anxiety Scale (Brown et al., 1997).

5.2. Apparatus

The program and strategy used for the FIPD in this study was identical to that used in the first, with the following exceptions. First, the game used a modified Raise the Stakes (MRTS; Roberts & Sherratt, 1998) strategy that increased cooperation by two tokens more than the participant's previous turn if the participant met or exceeded the computer at that turn. The MRTS strategy was thus slightly more friendly than the FF strategy was in the first 10 turns; this strategy was selected to ensure that participants were likely to perceive the strategy as friendly. Second, the MRTS strategy did not unexpectedly completely defect. Third, both computer and participant were subject to errors of communication that could affect the delivered tokens by plus or minus 3. These errors were randomly generated, and it was intended that each participant would receive errors that were randomly distributed at the time of playing. However, the program did not execute this function properly, and nearly all participants (n =138) were subject to the same error turns, which consisted of three participant turns and one computer turn. The remaining participants experienced (a) errors on different turns and (b) an additional error turn. Neither participants nor experimenters were aware of the turns on which errors were most likely, and participants were not aware of whether the computer's donation was affected by error on each turn. The communication errors were thus effectively random.

5.3. Measures

In addition to the SIAS, participants also completed the following measures, which are standard measures of their respective constructs and are thus not reviewed in detail. These measures included: (a) The Beck Depression Inventory-II (BDI-2; Beck, Steer, & Brown, 1996) as a measure of depression (α = .85) (b) the Social Phobia Scale (SPS; Mattick & Clarke, 1998) as a measure of fear of scrutiny (α = .85), and the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) as a measure of positive and negative activated affect (αs = .86). Additional measures included:

The Favor Scale (Fernandez & Rodebaugh, 2010) is a measure of participant responses to friendly giving that are associated with social anxiety. The 22-item scale given here was in development at the time of this study, but includes the final 11 items reported on by Fernandez and Rodebaugh (2010). Here we concentrate on the *negative reactions to favors* (NEG) subscale, which consists of four items rated on a 1 (*not at all true*) to 7 (*completely true*) Likert-type scale. Participants are asked to report their reactions to favors from friends, and the NEG items reflect feeling awkward around the friend and guilty until the favor is returned, as well as hesitance about asking for help prior to returning the favor. The scale as a whole shows strong factorial validity, ethnic invariance across white and Asian American undergraduates, and gender invariance. The NEG subscale correlated most strongly with social anxiety across multiple studies, and in one study carried the indirect effect of social anxiety on friendship impairment (through another subscale of the Favor Scale). Notably, Fernandez and Rodebaugh's Study 2 used the participants from this study, although data from the FIPD was not explored. The NEG had strong internal consistency in this sample ($\alpha = .81$).

Friendliness and Frustration items were created for this study. The Friendliness subscale asked participants to rate how (a) "friendly" and (b) "much like a close friend" the player was, as well as to what extent the participant would "like to get to know a person" like the player. The Frustration subscale asked how "frustrating" the other player was, how "angry" the other player made the participant, and "how annoyed" the participant would be at a player like this one. The two types of items were interspersed on the same page, and participants were asked to respond on a 0 (*not at all*) to 9 (*very much so*) Likert-type scale. The two subscales were postulated a priori; when tested using a confirmatory factor analysis in these data using maximum likelihood factor analysis in Mplus (Muthén & Muthén, 1998-2006), fit was acceptable to good (Comparative Fit Index [Bentler, 1990] = .96, Standardized Root Mean Square Residual [Bentler, 1995] = .06). The latent variables were moderately and inversely correlated ($r = -.39$, $p < .001$). In addition to face validity, then, the items appeared to cluster in two factors,

Friendliness and *Frustration*, as hypothesized. Both subscales had excellent internal

consistency in this sample (αs > .81).

Mini-International Personality Item Pool (MINI-IPIP; Donnellan, Oswald, Baird, &

Lucas, 2006) is a 20-item measure of the broad five factors of personality that asks participants

to respond on a 1 (*Very Inaccurate*) to 5 (*Very Accurate*) Likert-type scale. Donnellan et al.

report that this set of items drawn from the International Personality Item Pool has acceptable

convergent, discriminant, and criterion-related validity. We used this scale because the broad

factors of neuroticism, extraversion, and agreeableness might be expected to account for any

relationship between interpersonal constraint and giving. In the current study, extraversion and

neuroticism showed good internal consistency (αs > .73). Agreeableness showed weaker

internal consistency (α = .57), but this was improved when one item (item 7) was deleted (α =

.65). The resulting internal consistency was acceptable and the facet of agreeableness that was

of most interest (trust) was also measured separately (see below).

International Personality Item Pool Facets were drawn from a 120-item International

Personality Item Pool representation of the 30 facets of the big five factors derived by Johnson

(2001, May). Items were similar in structure to the MINI-IPIP items and were thus simply

appended after those 20 items. Participants rated the items using the same scales. These items

assessed seven facets selected by the first author as of interest in the study of social anxiety;

this study focuses on the facets of trust (also referred to in the literature as A1; *[I] Trust others*)

and trait anger (N2; *[I] Lose my temper*), neither of which are well-represented in their

respective broad factors. Each facet was included four items that represented the four strongest

items for measuring that facet according to a very large dataset analyzed by Johnson (2001,

May). In the current study, each facet showed excellent reliability (αs > .86).

5.4. Procedure

The procedure was identical to Study 1, with the exceptions that: (a) the questionnaire

packet was longer, including the measures listed above as well as others not used here; (b)

participants were randomly assigned to instructions to react as if the computer was a Friend

("someone you know very well and are friendly with**;** n = 47), Stranger ("a person, but someone

you do not know and will not meet**;** n = 46), or Computer ("a computer playing according to

pre-programmed instructions**;** n = 48); and (c) participants completed 15 turns with the game.

Participants completed the friendliness and frustration items after playing the game.

6. Results and Discussion

6.1. Condition Differences and Friendliness of the Friend Condition

Initial equivalence. The three conditions showed no significant differences in

distribution of gender, ethnicity, and age (all ps > .100). The participants across the three

conditions also had equivalent scores on all of the trait-level measures tested (all ps > .06).[2]

Condition effects on behavior and perception. The hypothesis that participants would

donate more when told to play the game as if with a friend was tested with an ANOVA in which

Condition was the independent variable and participant giving across the 15 turns was the

dependent variable. Condition showed a large effect on participant behavior ($F[2, 138]$ = 15.82,

p < .001, partial η^2 = .19). Follow-up tests revealed that participants gave significantly more in

the Friend condition (M = 95.91, SD = 30.94) than the Stranger condition (M = 71.61, SD =

30.46; $t[91]$ = 3.82, p < .001) and the Computer condition (M = 60.22, SD = 33.09; $t[93]$ = 5.43,

p < .001). Both of these effects were medium to large (ds > .73). In contrast, the Stranger and

Computer condition showed only a trend toward a significant difference ($t[92]$ = 1.73, p = .087),

such that participants gave marginally more in the Stranger condition than the Computer

condition.

Whether participants perceived the strategy differently by condition was tested by

submitting ratings of friendliness and frustration to a MANOVA with Condition predicting both

dependent variables. Two participants provided only partial data on the friendliness and

frustration measure and are therefore not available for related analyses. Condition showed a

strong multivariate effect (Wilk's λ = .66, $F[4, 270]$ = 15.76, p < .001, η^2 = .19). Further

exploration of this effect found that participants judged the computer in the Friend condition to be the most friendly (M = 22.13, SD = 4.33) and least frustrating (M = 2.77, SD = 3.51). In comparison to the Friend condition, the computer in the Stranger condition was judged to be both less friendly (M = 17.04, SD = 5.24, t[90] = 5.08, p < .001) and more frustrating (M = 4.39, SD = 3.85, t[91] = 2.13, p = .036). Comparisons to the Computer condition yielded similar results (friendliness: M = 12.81, SD = 6.46, t[80.39] = 8.21, p < .001; frustration: M = 4.96, SD = 4.35, t[92] = 2.69, p = .009). In contrast, although the Stranger condition was judged to be more friendly than the Computer condition (t[90] = 3.45, p = .001), it was not judged to be more frustrating (t[91] = 0.66, p = .508). Overall, as hypothesized, participants behaved toward the computer differently and reported perceiving the computer differently depending on condition.

6.2. Effects of Interpersonal Constraint on Giving Across Conditions

Because interpersonal constraint, represented by NEG, was expected to have an effect on giving only in the Friend condition, interaction effects between NEG and condition were first tested. Because two significance tests would be necessary regardless of strategy, we chose the strategy of testing: (a) an interaction between NEG and condition when only the Friend and Computer conditions were selected and (b) the same interaction but with only the Friend and Stranger conditions selected.

Interactions were tested with multiple regression, and in each case the interaction term between NEG and condition was statistically significant and moderate in size (Friend vs Stranger: part r = -.21, p = .017; Friend vs. Computer: part r = -.25, p = .010). The nature of these effects was explored by examining the effects of NEG within each condition. NEG did not show a relationship with giving in the Stranger or Computer condition (ps > .49). In comparison, NEG showed a strong effect in the Friend condition (r = -.40, p = .005). Participants who reported experiencing more guilt, awkwardness, and pressure to reciprocate when receiving favors from friends gave less during the task. As can be seen in Figure 2, participants with lower

NEG scores preferentially gave more in the FIPD when imagining playing a friend. In contrast, participants with higher NEG showed less of a preference for giving to friends.

Moderation of NEG effect. Given the results of Study 1, it might be expected that the effects of NEG on giving should also be moderated by gender. NEG, gender, and their interaction were entered into a regression to predict giving in the Friend condition. Neither the interaction term nor gender were significant predictors (ps > .51), indicating that the effect of NEG was not moderated by gender in these data.

Robustness of NEG effect. Might the effects of NEG in the Friend condition be better explained by some other variable? Because NEG represented a proposed mediator in any relationship between social anxiety and giving, it should remain statistically significant above and beyond social anxiety variables. In addition, it should also remain statistically significant above and beyond constructs representing alternative explanations of the effects (e.g., depression, personality traits), unless those constructs represent more viable mediating variables. We therefore conducted a regression within the Friend condition in which the following variables predicted giving: SIAS, SPS, BDI, trait PA, trait NA, the personality traits of extraversion, neuroticism, and agreeableness, and the personality trait facets of anger and trust. In this complex regression, one participant was removed due to excessive SDBETA scores, leaving 47 participants for this analysis. The regression is presented in Table 1. As can be seen in the table, only NEG showed a unique effect in predicting giving. Thus, the effect of NEG on giving was robust above a wide variety of predictors.

Indirect effect of social anxiety. To test the indirect effects of social anxiety on giving through NEG, we first created a composite social anxiety variable by standardizing the SIAS and SPS and combining them as an overall measure of social anxiety symptoms. We then used the macro written by Preacher and Hayes (2008) to test the indirect effect of social anxiety symptoms. The 95% confidence interval for the indirect effects was -5.93 to -.33. Because this confidence interval did not include zero, the indirect effect was statistically significant at p < .05.

The data thus supported a significant indirect effect of social anxiety on giving, through

interpersonal constraint. We also tested the indirect effects of NEG through SIAS and SPS

separately; in each case, the 95% confidence interval did not include zero, indicating that the

indirect effect was statistically significant. In contrast, when depression, as measured by the

BDI-2, was tested as the construct mediated by NEG, the confidence interval contained zero,

indicating that there was specificity to the findings of indirect effects for social anxiety variables.

Direct effects of social anxiety. Some guidelines for establishing mediation (Baron &

Kenny, 1986) require a direct relationship between the variable to be mediated and the

outcome. In these data, the SPS related directly to giving in the friend condition (r = -.31, p =

.037), but neither the straightforward SIAS nor the composite did so (ps > .251). Notably, we did

not necessarily expect such direct relationships; nor are such relationships required according

to many contemporary understandings of statistical mediation (Hayes, 2009).

7. **General Discussion**

We conducted this pair of studies to assess the utility of the FIPD in understanding

impairment in friendships related to problematic social anxiety and its interpersonal correlates.

As predicted, participants responded to the FIPD differently depending on both the computer's

actual behavior (i.e., cooperation vs. defection; Study 1) and participants' mental models of *who*

they were playing with: a computer, a stranger, or a friend (Study 2). We initially expected direct

relationships between social anxiety and task behavior, but this hypothesis was only partially

supported by Study 1, in which such an effect was found for men but not women. In contrast,

Study 2 supported an arguably more plausible model that social anxiety leads to chronic

interpersonal constraint, which in turn contributes to task behavior. The direct effect of

interpersonal constraint on task behavior was not moderated by gender; neither was it mediated

by a variety of competing constructs, including depression, personality traits, and trait negative

and positive affect.

The current results are broadly consistent with previous evidence derived from self-report (e.g., Fernandez & Rodebaugh, 2010) and observation of interaction with strangers (e.g., Meleshko & Alden, 1993) suggesting that people with higher social anxiety display constricted positive reciprocity in interpersonal contexts. The current results suggest that such constriction is detectable using an FIPD, although it may only be detectable in reference to close relationships (e.g., such as friendships). Notably, such constriction was not detected when participants imagined the FIPD was a stranger, despite detection of similar effects in previous studies involving actual interactions with strangers (Meleshko & Alden, 1993; Walters & Hope, 1998). The FIPD may thus not be as sensitive to such behaviors compared to coding of actual interactions with strangers. It should be noted, however, that our instructions explicitly directed participants to imagine that they "would not meet" the stranger they were imagining playing with. It is possible that if participants were instructed to imagine that they would meet the person in the future, findings might be different. Further study will be necessary to determine under what conditions the FIPD is sensitive to behavior related to interpersonal impairment.

The current results add additional support to the proposition that excessive social anxiety impairs friendship through constraint of positive reciprocity. Notably, the evidence in this case comes from a sample of behavior in simulation and not self-report alone, whereas previous investigations of the same effects in friendships has been reliant upon self-report alone (Fernandez & Rodebaugh, 2010; Rodebaugh, 2009; Schneier et al., 1994). Although the report of the *friends* of people with problematic social anxiety is clearly of interest, the current study strongly suggests that social anxiety has an indirect impact on behavior in friendships that is likely to lead to lower satisfaction of the friends in the relationship.

Two lines of future research are suggested by the results of these studies. The first is the use of the FIPD to examine interpersonal behavior in people with and without problematic social anxiety, in reference to multiple relationships. This use of the FIPD lends itself to an analysis of interpersonal behavior that is grounded in behavioral economic principles. For

example, it becomes feasible to understand the apparent interpersonal dysfunction displayed by people with problematic social anxiety as reflecting a strategy of investment driven by definable assumptions. Some people with higher social anxiety appear to begin to respond to investment by friends (e.g., favors) as if such behaviors are negative. Established research and theory suggests that such reactions are rooted in fears of evaluation (e.g., Heimberg et al., in press) and the assumption that returning favors or reciprocating friendly gestures will lead to greater scrutiny from even close friends and might result in rejection due to flawed personal characteristics (e.g., Moscovitch, Orr, Rowa, Reimer, & Antony, 2009). Given such assumptions, a rational agent should tend to limit investment, because imminent rejection, (modeled in the game as defection) would lead to loss of the resources invested. Without such assumptions, a rational agent should invest more in closer relationships, because these relationships should be less prone to unexpected rejection. Indeed, an evolutionary theory of friendship postulates that friendship is an adaptive strategy partially because, unlike other relationships between non-kin, it establishes a bond that leads to consistent mutual investment even when the situation might seem to call for defection (Tooby & Cosmides, 1996). Notably, in the current results, participants who were more likely to view favors as negative did not have lower investment in general in the task. Instead, in comparison to participants without such tendencies, they showed a specific lack of investment in friendships. This finding is consistent with previous work suggesting that people with problematic social anxiety may be less sensitive to cues of increasing positive reciprocity (e.g., escalating intimacy in conversation; Meleshko & Alden, 1993). The current findings thus suggest a variety of additional studies using the FIPD to more clearly examine under what circumstances problematic social anxiety may indirectly reduce investment in relationships.

A second area of research suggested by these findings involves direct examination of existing relationships of people who (a) do and (b) do not have problematic social anxiety. As noted in the introduction, such studies carry particular difficulty because they demand the

recruitment of both participants with clinical disorders and their existing relationship partners. However, the current findings suggest that the problematic interpersonal behaviors seen in interactions with strangers might actually be more strongly apparent in relationships with established friends (or romantic partners, as already suggested by previous studies: Beck et al., 2006; Wenzel, 2002). Importantly, resolving the interpersonal dysfunctions related to problematic social anxiety may require more direct information about the way these dysfunctions are expressed in actual interpersonal interaction. Existing treatments may already adequately address these dysfunctions, but if this is the case, it is difficult to understand self-report findings, which indicate that people with social anxiety disorder experience increases in quality of interpersonal relationships through treatment, but that these increases are smaller than typically observed in other disorders (Eng, Coles, Heimberg, & Safren, 2001). Without direct observation, it will remain unclear whether these findings reflect continued dysfunction in interpersonal perception alone, relationships themselves, or both.

The two areas of research described above might be best pursued in concert. Combining the FIPD and standard interpersonal tasks (such as those used in the marital literature: Heyman, 2004; Pasch, Harris, Sullivan, & Bradbury, 2004) in the study of people with higher vs. lower social anxiety would afford several advantages. The validity of the FIPD itself could be further tested, thereby determining whether its use in further studies should be encouraged. Further, the direct observation of behavior in existing relationships would help answer many questions about how people with social anxiety disorder come to find their relationships impaired and unsatisfying.

The limitations of the current studies should be considered when interpreting these results. The participants were undergraduates, most of whom are unlikely to have significant problems with social anxiety. However, based on established cut-offs, a fair portion of each sample was likely to have such problems. Further, it is not immediately clear why a sample with less representation of severe social anxiety would produce erroneously significant results; it

seems far more likely that the current effects are underestimated because problematic social anxiety is underrepresented in the sample. Indeed, the inconsistent direct relationship between social anxiety and behavior on the task might be due to these sample characteristics. Regardless, it would clearly be useful to test our hypotheses in samples with different characteristics, including samples of people with and without social anxiety disorder. The fact that our samples were largely female and white should also be considered; the extent to which findings generalize to diverse samples is an important question. More broadly, it should be emphasized that these studies are initial tests of the proposition that the FIPD might be useful in exploring interpersonal constraint. Questions about its ecological validity will remain until many additional tests are performed.

Our finding that a trait-like tendency to have negative reactions to favors carries the indirect effects of social anxiety to behavior in the task may not be convincing to some readers as a demonstration of mediation. Many readers will be most familiar with Baron and Kenny's (1986) tests for mediation, which require a direct effect between the first variable in the sequence and the outcome. However, more recent accounts of statistical mediation suggest that the requirement of a direct effect is not consistent with the concept of an indirect effect (Hayes, 2009). In this case, it should be noted that we would expect a direct effect (and, thus, full mediation according to Baron and Kenny) in a sample that included a reasonably large number of participants who had problematic social anxiety and a comparable number without such problems. A comparison between participants with and without generalized social anxiety disorder would be sufficient for this purpose. It should also be noted, however, that a full test of mediation would require longitudinal data. For example, it remains possible, given our data, that a trait-like tendency to experience negative reactions to favors from friends produces *both* social anxiety and reactions to the FIPD. That is, our data cannot establish the direction of causality between interpersonal dysfunction and social anxiety.

Taken together with their limitations, the current studies provide support for two propositions. First, they provide preliminary support for the use of an FIPD as a tool in understanding the interpersonal problems related to excessive social anxiety. Second, they provide additional support for the proposition (e.g., Alden & Taylor, 2004) that social anxiety produces interpersonal problems at least partially through constraining positive reciprocity. Collectively, these findings advance theoretical understanding of the mechanisms affecting friendship dysfunction associated with social anxiety and, in addition, introduce a new methodological approach that balances the ideal of studying real-world interpersonal interactions against pragmatic constraints on resources and the desire to maintain a high degree of experimental control.

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9. Footnotes

[1]In a pilot study, we found that most participants detected a difference between a purely friendly strategy and a strategy that randomly defected when 20% of turns involved defection.

[2]Only trait negative affect as measured by the PANAS showed a trend effect; other ps were greater than .20. Trait negative affect was highest in the computer condition and lowest in the friend condition, with a difference of 2.81 points in total. Given that 12 tests were conducted for initial equivalence, the presence of one trend seems unremarkable. Note that, as shown in Table 1, trait negative affect did not account for the relationship between NEG and giving in the Friend condition. When trait negative affect was equated post-hoc by removing 5 extreme scores from the sample, substantive results were similar (with minor differences in significance levels). More specifically, tests of indirect effects reached the same conclusions in this subsample. Further, in additional tests with the entire sample, trait negative affect did not moderate the indirect effect of social anxiety on giving through NEG. We therefore conclude that this potential failure of random assignment had minimal effects on the results.

Table 1

Simultaneous Multiple Regression Predicting Giving In Study 2 Friend Condition

Predictor	*B*	*SE B*	β	Part *r*	*p* value
NEG	-3.35	1.21	-0.46	-.35	.009
SIAS	0.54	0.57	0.20	.12	.354
SPS	-17.88	12.23	-0.26	-.19	.153
Positive affect	-0.04	0.86	-0.01	-.01	.966
Negative affect	2.50	1.32	0.38	.24	.067
Trust	-0.26	1.64	-0.02	-.02	.877
Extraversion	1.26	1.50	0.16	.11	.407
Neuroticism	-2.16	2.18	-0.18	-.13	.329
Agreeableness	-2.92	2.88	-0.17	-.13	.318
BDI-2	-38.75	30.72	-0.21	-.16	.216
Anger	1.68	1.28	0.22	.17	.197

Note. NEG= negative reactions from friends subscale of Favor Scale; SIAS= Social Interaction Anxiety Scale; SPS= Social Phobia Scale; BDI= Beck Depression Inventory-2.
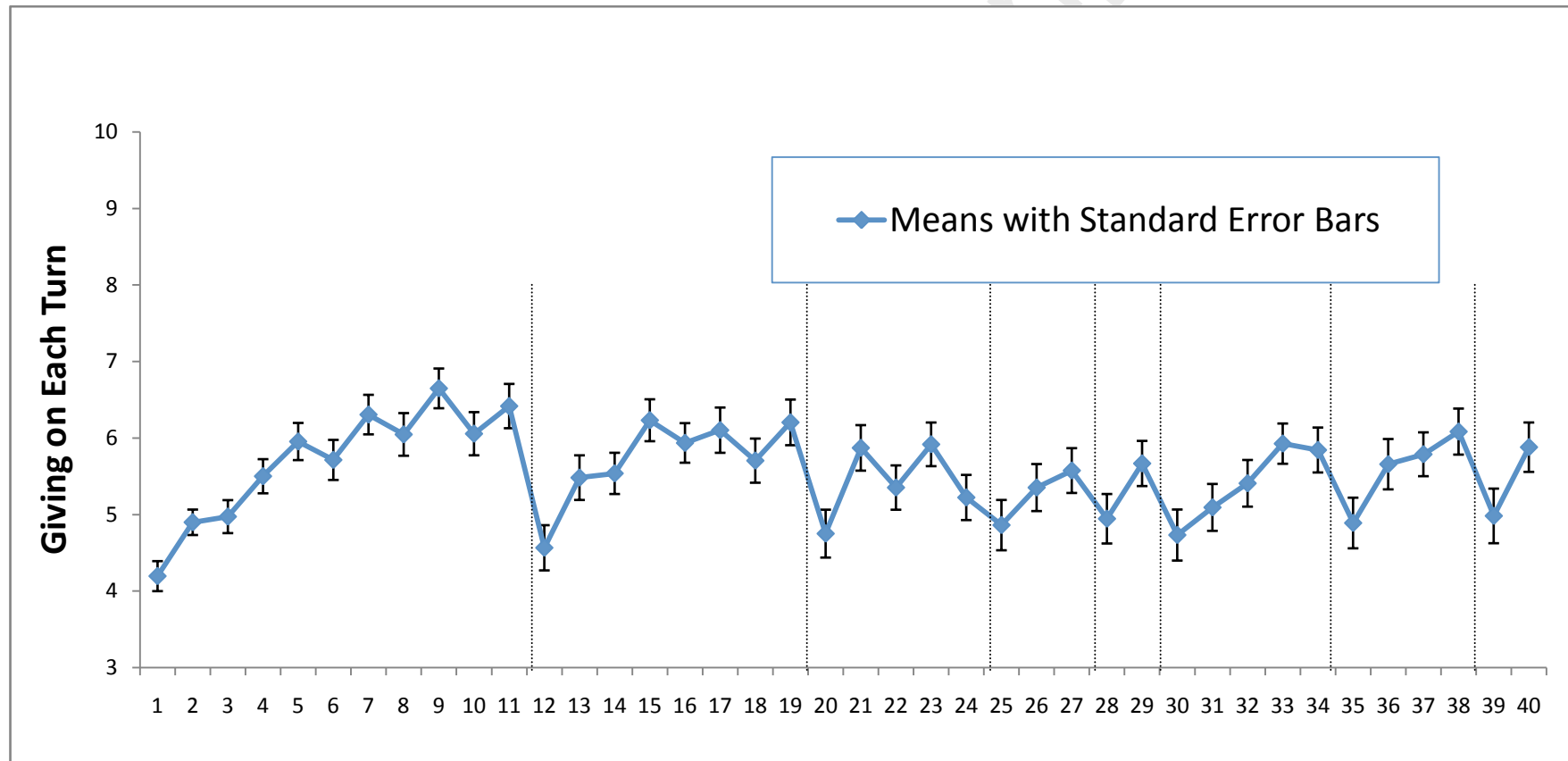
Figure 1. Giving on each of 40 turns for participants in Study 1. Points of defection by the computer are indicated by dashed lines.
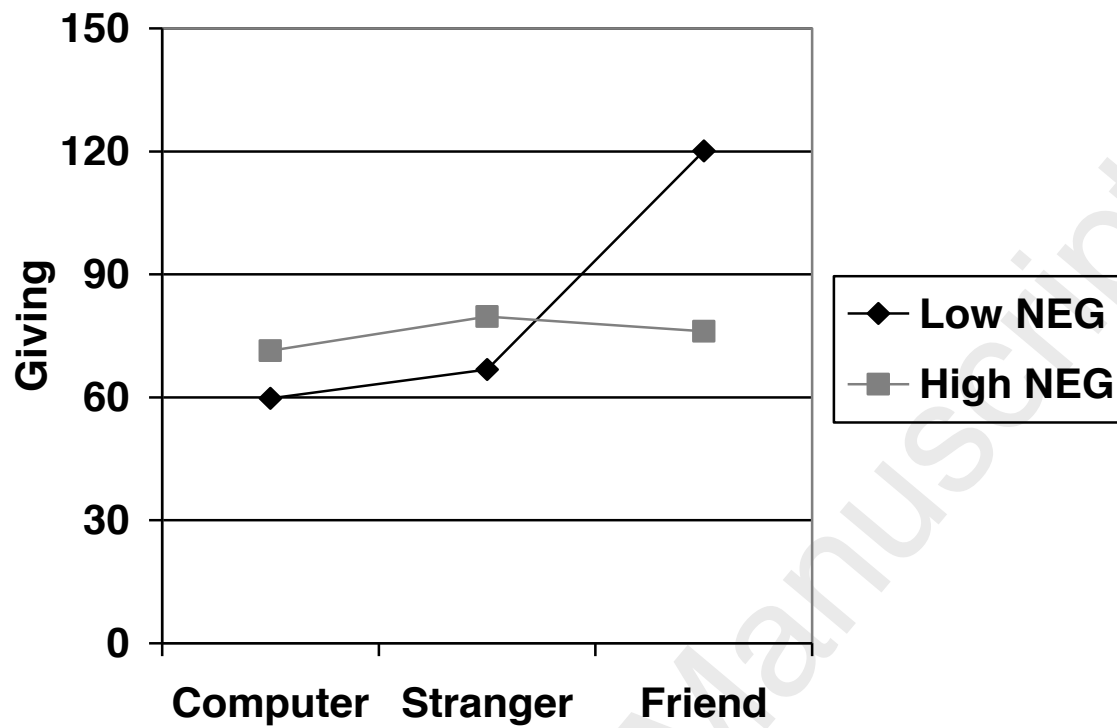
Figure 2. Giving across 15 turns in each condition for participants with lower and higher scores

on the measure of negative reactions to favors. NEG = Negative reactions to favors from the

Favor Scale. Participants with higher scores are above one standard deviation above the mean;

participants with lower scores are below one standard deviation below the mean.

- Giving on a prisoner's dilemma correlated with trait-like interpersonal constraint
- Giving behavior was also consistent with expectations based on actual interactions
- Social anxiety indirectly influenced giving through interpersonal constraint
- Constraint of positive reciprocity may underlie relationship impairment