THE YALE INTERPERSONAL STRESSOR (YIPS): AFFECTIVE, PHYSIOLOGICAL, AND BEHAVIORAL RESPONSES TO A NOVEL INTERPERSONAL REJECTION PARADIGM[1,2,3,4]

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ABSTRACT

Given links between interpersonal functioning and health as well as the dearth of truly interpersonal laboratory stressors, we present a live rejection paradigm, the Yale Interpersonal Stressor (YIPS), and examine its effects on mood, eating behavior, blood pressure, and cortisol in two experiments. The YIPS involves one or more interaction(s) between the participant and two same-sex confederates in which the participant is made to feel excluded and isolated. In Experiment 1, 50 female undergraduates were randomly assigned to the YIPS or a control condition. Participants in the YIPS condition experienced greater negative affect and less positive affect than did those in the control condition. Further, restrained eaters ate more following the YIPS than did nonrestrained eaters. In Experiment 2, 25 male and female undergraduates completed the YIPS. The YIPS induced significant increases in tension, systolic blood pressure (SBP), and diastolic blood pressure (DBP) from baseline, while significantly decreasing positive affect. The YIPS appeared particularly relevant for women, resulting in significantly greater increases in cortisol and SBP for women compared to men. The YIPS, then, provides an alternative to traditional, achievement-oriented laboratory stressors and may allow for the identification of individuals most vulnerable to interpersonal stress.

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INTRODUCTION

Despite the growing body of research linking adaptive interpersonal functioning with health (1–4) and maladaptive social circumstances with disease and premature mortality (5–8), investigators have only recently begun to examine social factors in the context of the psychophysiological stress reactivity (9–11). Given links between interpersonal functioning and disease, the development of appropriate interpersonal laboratory stress paradigms is critical both for identifying individuals at increased risk for disease and for elucidating situation-specific psychophysiological processes leading to disease (12,13).

Numerous studies in areas ranging from marital conflict to eating disorders have described "interpersonal," "relationship," or "social" stressors. We contend, however, that although most previous interpersonal stressors have involved an interaction component, the actual tasks can more accurately be defined as agentic, achievement, or goal-directed. For example, typical interpersonal speech stressors involve speaking before an audience or the threat of speaking before an audience (14–17). However, although the audience is a primary component of these stress inductions, it is typically silent or nonexistent. Distress results primarily from performance before the audience, as there is no real interaction with the audience.

Similarly, interpersonal cooperation stressors have required participants to interact with another person (spouse or another participant) in order to exert influence, or else to solve a difficult task (9,18–20). Although such task-oriented discussions require interactions among participants, discussions tend to focus on a goal—namely, persuasion of another participant or completing a difficult task. Cooperation stressors, then, may be better characterized as agentic challenges, although the goals are accomplished through the use of interpersonal interactions.

Harassment paradigms, in which participants complete difficult tasks in the presence of a harassing confederate, have also been labeled as interpersonal (21–23). Here again, we contend that although hostile interactions are a primary component of typical harassment paradigms, the interaction serves to disrupt a goal-directed, agentic challenge, rather than itself being the cause of distress.

Only a small number of laboratory paradigms have involved social interactions as the primary means for inducing distress.

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[2] We thank the General Clinical Research Center at Yale for carrying out the salivary cortisol analyses for the study. We also thank two anonymous reviewers for their helpful comments on a previous draft of this article.

[3] Portions of this article were presented at The Society of Behavioral Medicine Annual Meeting, San Diego, CA, March 1999.

[4] Special Note: The YIPS was developed by the second and third authors.

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Marital conflict stressors, for example, require couples to discuss and attempt to resolve their most conflictual relationship issues in the laboratory (24–27). These paradigms result in significant increases in cardiovascular, neuroendocrine, and immune parameters, the most potent of which occur in the wives (26,27). However, although marital conflict tasks are excellent examples of live social interaction stressors, the requirement of a spouse or long-term partner render such paradigms less suitable for single participants.

Recently, Larkin et al. (28) and Waldstein et al. (29) described a role-played interpersonal interaction protocol designed specifically for undergraduate participants. In these paradigms, participants are presented with a number of interpersonally challenging scenarios (e.g. roommate continually leaves apartment messy) and then are asked to role-play the situation with a confederate. Although these paradigms were effective with undergraduates and the distress induction revolved primarily around interpersonal concerns, the actual challenge was role-played, and thus did not involve a live interpersonal challenge.

Finally, although not designed as stress induction, Williams and colleagues (30,31) have developed several exclusion paradigms to investigate their social psychological model of ostracism (30). In these paradigms, participants are either actually ostracized by two confederates who exclude the participant from a game of ball-tossing or a conversation, or else they are asked to imagine being ostracized. Although these ostracism paradigms have been shown to influence behavior (30,31), they were developed in order to allow manipulation of a theoretical construct. Thus, they have not been examined in the context of a stress induction (e.g. changes in affect or physiological measures following the ostracism).

We saw a need for the development of a live, interpersonal interaction stressor without the requirement of a long-term partner. In the present study, we define interpersonal as referring specifically to social interactions, and contend that a truly interpersonal stressor should involve distress concerning social interactions, rather than agentic challenges (e.g. speech stressors) or interactions that are part of a goal-directed challenge (cooperation or frustration tasks). The Yale Interpersonal Stressor (YIPS) was developed to fit these requirements. Our primary aim in this article, then, is to introduce the YIPS, a novel interpersonal rejection paradigm, and to examine its effects on mood, eating behavior, blood pressure, and cortisol in two studies. Given that women have typically shown greater physiological responses to marital interaction challenges (26,27) and that restrained eaters appear more affected by interpersonal stress manipulations than unrestrained eaters (14,15,32,33), we also examined differential effects of the YIPS on men and women and on restrained and unrestrained eaters.

EXPERIMENT 1: OVERVIEW AND HYPOTHESES

Female participants were assigned randomly to one YIPS interaction or a control condition, after which affect and eating behavior were measured. We hypothesized that individuals assigned to the YIPS would experience greater negative affect and less positive affect than individuals assigned to the control condition. We also tested the hypothesis that restrained eaters would eat more following the YIPS than unrestrained eaters, but that there would be no differences in eating between restained and unrestrained eaters following the control condition.

METHOD

Participants

Fifty female undergraduates (ages 18–20) were recruited from Yale Introductory Psychology classes and received one course credit for their participation. Body mass indices (BMI) (weight in kilograms/[height in meters]^2) ranged from 17 to 27 (M = 21.85, SD = 2.21). Two participants assigned to the YIPS were dropped; the first knew one of the confederates, and the second had recently learned about similar stress and eating studies in a psychology course.

Procedure

Experiment 1 was part of a larger study examining the impact of interpersonal and ego-related stress on restrained eaters (34). As eating was a dependent variable, sessions took place during the mid-morning or mid-afternoon to avoid cueing mealtime hunger. Participants were randomly assigned to either the YIPS (n = 24) or a control condition (n = 26).

Yale Interpersonal Stressor (YIPS): The YIPS involved two extensively trained female confederates who posed as Introductory Psychology students. One confederate was waiting in the laboratory when the participant arrived; the other always arrived several minutes after the participant. Once all were present, the participant and confederates were told that they would be taking part in an investigation of social interactions and abilities in communication. Participant and confederates were then asked to introduce themselves, stating their first name, year in school, and residential college. In order that participants not attribute rejection to differences in year in school, confederates indicated that they were the same year as the participant, but lived in a different residential college (similar to a dormitory). Participant and confederates were then asked to initiate a 5-minute discussion of "how undergraduates get to know one another at Yale." After giving instructions, the experimenter left the discussion room.

Confederates then allowed the participant to begin the discussion (to give confederates material with which to disagree). Although the confederates initially responded to the participant with a "pretext of civility," they gradually began to use a variety of techniques to exclude the participant. Exclusion of the participant began slowly and built gradually so that it appeared to be the result of the content and style of the participant's conversation, rather than any external characteristics. Exclusion techniques included disagreeing with, ignoring, and criticizing any efforts the participant made at conversation. For example, when the participant offered a suggestion for how to get to know people, the confederates would dismiss the participant's suggestion with, "that idea is okay, but her (other confederate's) idea seems better and more practical." Besides verbally excluding the participant, confederates also used nonverbal cues to isolate the participant. Confederates gradually shifted their bodies and chair positions away from the participant, and greeted participant's statements with little or negative facial acknowledgment. In addition to excluding the participant, confederates also appeared to connect well with each other, typically agreeing with, approving of, and praising each other's efforts at conversation; shifting body posture toward the other confederate; and providing positive facial acknowledgment when the confederate spoke.

An example of a YIPS segment follows: a freshman participant mentioned a pizza restaurant known as a typical freshman hang-out as a potential means for meeting people at Yale. Confederate 1 explained that she preferred a different pizza

restaurant typically not frequented by freshmen. Confederate 2 agreed vigorously (nodding, smiling, and verbally) with the first confederate, and explained that she had really tired of the restaurant named by the participant and further, did not think highly of people who spent time at this restaurant. The two confederates then began talking and laughing about a particular professor who frequented the pizza restaurant they enjoyed. As they engaged each other in discussing the professor, they gradually shifted their bodies and chairs toward each other and away from the participant.

Following the 5-minute discussion, the participant was taken to another room and told that she would not be seeing the other participants again. The participant then completed the Bogus Social Perceptions Questionnaire (BSPQ) for each confederate, and was told that the other participants were completing the same questionnaire simultaneously. After several minutes, the experimenter collected the participant's BSPQ, then returned to show the participant two precompleted copies of the BSPQ, purportedly filled out by the other participants. Both of the bogus questionnaires indicated that the participant was not perceived by either confederate to be socially or interpersonally competent (see BSPQ below).

Control Condition: Participants assigned to the control condition were presented with a page of randomly typed letters and asked to circle every fifth "e." They were told to take their time and that "most people don't finish." This condition also lasted for 5 minutes. Following either the YIPS or the control condition, participants completed the Sensation Questionnaire. All participants were then asked to complete an ice cream taste test as part of a separate "taste perception" experiment.

Ice Cream Taste Test: Participants in both conditions were presented with three cartons of ice cream, dishes, spoons, and forms to rate each flavor. Each carton contained 500 grams of ice cream. Participants were asked to taste and rate each of the flavors. As the experimenter left the room, she stated, presumably as an afterthought, "You are the last student today and we'll be throwing out any leftover ice cream. So, after you finish all your ratings, please feel free to help yourself to as much of any flavor as you like." Participants were then left alone in the room for 5 minutes to eat as much ice cream as they pleased. Ice cream was weighed before and after the taste test to determine amount consumed.

Next, participants completed the Revised Restraint Scale (RRS) and provided demographic information including age, height, weight, and class year. As is typical in stress and eating experiments (33,35), height, weight, and restrained eating were assessed following the experimental manipulation and ice cream challenge to avoid cueing participants to a main dependent variable before it was assessed. Extensive debriefing followed.

Measures

Sensation Questionnaire: The Sensation Questionnaire (35) consists of 24 mood adjectives of which 14 are designated as negative (annoyed, anxious, apprehensive, bored, confused, depressed, distressed, fearful, hopeless, irritated, jittery, nervous, sad, uncertain) and 10 as positive (cheerful, content, elated, enthusiastic, euphoric, excited, happy, lighthearted, lively, peppy). Adjectives were rated along 7-point Likert scales. Negative and positive subscale scores were obtained by summing the items for each dimension minus the item "euphoric" that did not load highly on either scale. Both subscales had good internal consistency (Cronbach's alphas were .91 for each).

Revised Restraint Scale (RRS) (36): A reliable and valid measure of chronic dieting status that was the field standard when the study was conducted (37). It includes 10 questions rated along 5-point Likert scales covering current dieting habits, weight fluctuation history, and excessive concern about eating. Items are summed to give a total ranging from 0 to 50. As suggested by Heatherton et al. (38), participants with scores of 15 (median) or higher were designated as "restrained eaters," while those with scores below 15 were categorized as "unrestrained eaters."

Bogus Social Perceptions Questionnaire (BSPQ) (34): A 12-item measure of participants' opinions of each of the two other participants (confederates). Nine items were measured along 5-point Likert scales (e.g. "This person is probably shy," "This person seemed at ease in the conversation we just had"). Three items requested "yes" or "no" answers (e.g. "I would like to get to know this person better," "I would prefer to keep this person simply as an acquaintance"). Several copies of the BSPQ were used in the YIPS condition. After the YIPS, the participant first completed this questionnaire for each confederate. Then, the participant was shown precompleted versions of the BSPQ purportedly filled in by the other participants. Responses in the precompleted BSPQs indicated that the participant was rated negatively by the other participants. For example, for the statement, "This is a person who is probably comfortable in most social situations," the response "not at all characteristic" was circled. For "This is a person I would like to get to know better," the response "No" was circled.

Data Analyses

T-tests were conducted to assess differences in positive and negative affect following the YIPS and control conditions. Participants were then divided into restrained ($n = 25$) and unrestrained ($n = 25$) eaters based on a median split of the RRS. We then conducted a 2 (Restraint category) × 2 (Condition: YIPS or control) analysis of variance (ANOVA) with grams of ice cream consumed as the dependent variable (DV). Separate *t*-tests for YIPS and control conditions followed with Bonferroni corrections for multiple tests applied. As eating values showed high variability and were positively skewed, analyses were based on the natural logarithm of the eating values. However, nontransformed values are reported in the lists of means and in Figure 1. Effect sizes were calculated using the formula ($r = F/F + df_{error}$), with .10 considered a small effect, .30 a moderate effect, and .50 a large effect (39).

RESULTS

Affective Responses

Following the experimental manipulation, participants in the YIPS condition showed significantly greater levels of negative affect than did participants assigned to the control condition, $t(49) = 2.62$, $p < .05$ (Ms = 51.20 and 40.42, SDs = 14.7 and 14.6, respectively). Negative affect was 28% higher in the YIPS condition compared to the control, an effect size of .35. Participants in the YIPS also showed significantly lower levels of positive mood than did those who completed the control condition, $t(49) = 2.78$, $p < .01$ (Ms = 33.67 and 40.88, SDs = 10.0 and 8.1, respectively). Positive affect was 21% lower in the YIPS condition compared to the control condition, an effect size of .37.

Ice Cream Consumption

To test the hypothesis that restrained eaters would eat more than unrestrained eaters following the YIPS but no differences

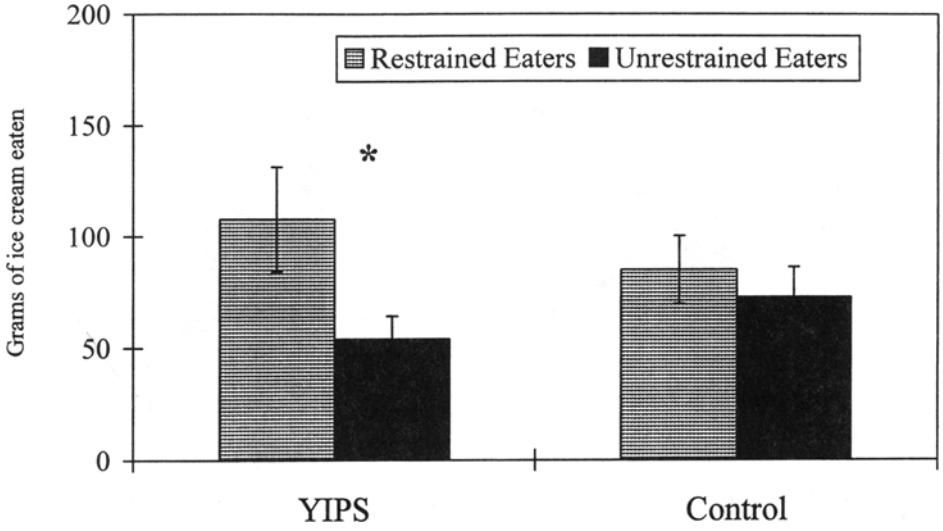

FIGURE 1: Grams of ice cream eaten (means ± SEM) by restrained and unrestrained eaters following the Yale Interpersonal Stressor (YIPS) or the control condition. Differences between restrained and unrestrained eaters significant at the $p < .05$ level by *t*-test are indicated with a *.

would emerge following the control condition, we conducted a 2 (restraint) × 2 (condition) ANOVA. Differences in eating by restraint and condition are shown in Figure 1. We found no significant interactions between restraint category and condition, $F(1, 46) = 1.96$, $p < .15$. However, *t*-tests with Bonferroni corrections examining the YIPS and control conditions separately revealed a significant difference in ice cream consumed between restrained and unrestrained eaters following the YIPS, $t(22) = 2.68$, $p < .02$, but no difference following the control condition, $t(24) = 0.30$.[5] As shown in Figure 2, restrained eaters ($n = 11$) ate significantly more ice cream (approximately double the amount of ice cream) than unrestrained eaters ($n = 13$) following the YIPS (Ms = 107.91 and 53.92, and SDs = 78.13 and 36.75, respectively). Although we included a Bonferroni correction for the two *t*-tests, results should be interpreted with caution as the significant *t*-test followed a nonsignificant ANOVA. Further, as comparisons of restrained and unrestrained eaters separately across conditions revealed no significant differences, it is unclear whether the YIPS increased eating in restrained eaters, decreased eating in unrestrained eaters, or both. Effect size for the difference in consumption between restrained and unrestrained eaters in the YIPS was .41.

EXPERIMENT 2: OVERVIEW AND HYPOTHESES

Experiment 2 examined the effects of the YIPS on blood pressure, cortisol, and self-reported affect in a within-subject design. As more prolonged stress is typically required to increase cortisol (16,40), this experiment involved two longer YIPS interactions. To confirm the interpersonal nature of the YIPS, we initially conducted a preliminary study comparing undergraduates' perceptions of the YIPS to those of an agentic stressor. Next, for the main experiment, participants included male and female undergraduates, all of whom completed two YIPS interactions. Affect, blood pressure, and salivary cortisol were measured before, during, and after each interaction. We hypothesized that the YIPS would increase negative affect and decrease positive affect compared to baseline levels. We also expected that blood pressure and cortisol levels would increase significantly over the course of the session. Given women's greater physiological responses to marital stressors (26,27) and greater sensitivity to ostracism (30,31), we predicted that females would show greater increases in blood pressure and cortisol following the YIPS interactions compared with males.

METHOD

Preliminary Study

To confirm the interpersonal nature of the YIPS compared to an agentic stressor, we randomly assigned an independent sample of Yale undergraduates (27 males and 44 females) to read vignettes describing the YIPS ($n = 34$) or a more agentic stressor (math and verbal challenges with harassment; $n = 36$). Participants were then asked to rate the stressors along a number of dimensions using 7-point Likert scales. As expected, the YIPS was perceived as significantly more interpersonal, social, and interaction-oriented, and significantly less academic, achievement, and academic failure-oriented than the agentic stressor (Fs = 24.49 to 113.58, ps < .0001). When asked to rate the YIPS as either social or academic, 100% of participants described the YIPS as social; when asked to rate the YIPS as interpersonally- or achievement-oriented, 97% described the YIPS as interpersonal. Participants also perceived the YIPS as involving more social exclusion, rejection, and isolation and less performance and goal attainment (Fs = 6.52 to 60.82, ps < .05) than the agentic stressor. Finally, participants described the YIPS as significantly more similar to distressing social situations and less similar to academic situations than the agentic stressor (Fs = 40.18 and 10.36, respectively, ps < .005), and very similar to distressing social situations they had encountered ($M = 5.63$; $t = 9.17$, $p < .0001$).

Main Study: Participants

This experiment was part of a larger study examining sex differences in adrenocortical responses to achievement and interpersonal stress (40). Twenty-five healthy male ($n = 13$) and female ($n = 12$) undergraduates (ages 18–22) were recruited from Introductory Psychology classes or from flyers posted around campus.

[5] We also examined differences in restraint status by condition using specific contrasts and found the same pattern and significance of effects.

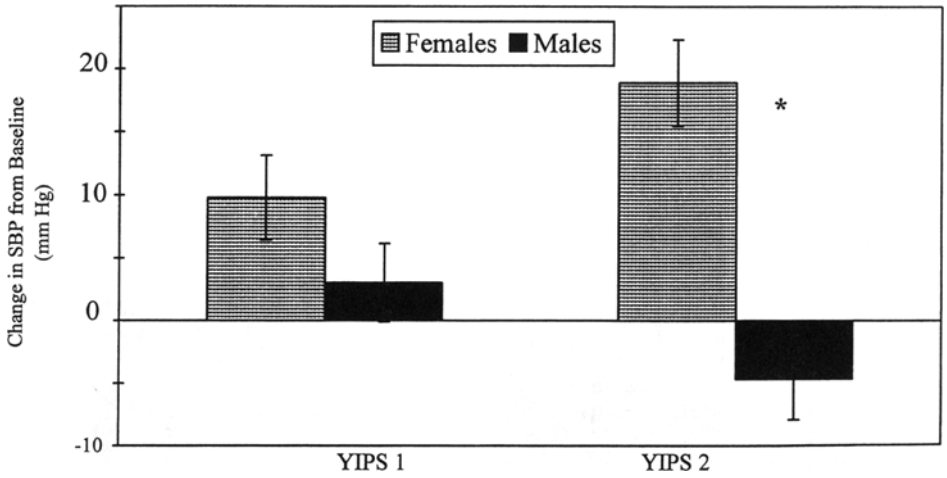

FIGURE 2: Change scores (from baseline) for systolic blood pressure (SBP) following the first and second YIPS interactions for males and females. Levels are means ± SEM controlling for baseline levels, age, and body mass index. Differences between males and females significant at the $p < .05$ level by Dunnett's t-test are indicated with a *.

Ethnic composition of the sample was 56% Caucasian, 12% African–American, 24% Asian–American, and 8% Hispanic. Participants received $10.00 plus two course credits or $25.00 for their participation. BMI for males ranged from 21 to 30 ($M = 24.44$, $SD = 2.42$) and for females from 14 to 25 ($M = 21.03$, $SD = 3.08$). Exclusion criteria were based on factors believed to influence physiological reactivity including history of physical or mental illness, use of prescription medications, smoking, and exercising more than 7 hours per week. Participants refrained from food and drink for 2 hours, from exercise or alcohol for 24 hours, and from caffeine for 12 hours before each session.

Procedure

To eliminate the effects of stress reactivity due to novelty, participants completed a separate rest session 2 or more days ($Mdn = 2$ days, Range = 2–41 days) prior to the YIPS session. Participants' height and weight were measured at the conclusion of this session for computation of body mass index. All YIPS sessions commenced between 3:00 p.m. and 6:00 p.m. to control for diurnal changes in cortisol secretion. Sessions lasted for approximately 2.5 hours and involved baseline, stress, and recovery periods. During the 20-minute baseline period, participants read a travel magazine and completed a short questionnaire while listening to soft, classical music. Two saliva and blood pressure (BP) samples and one affect measure were taken during this period.

YIPS: Study 2 involved two confederates who were the same sex as the participant. One confederate arrived before and one after the participant. When all were present, the experimenter conducted a "lottery" to determine which participant would be hooked up to the physiological monitors. The lottery was rigged so that the participant was always selected to be attached to the physiological equipment. Confederates and the participant were then led to separate rooms to fill out baseline questionnaires in private. Confederates were brought to the participant's room for each interpersonal challenge. Before the first interaction, the participant and confederates were told that we were interested in how individuals get to know one another and that they would discuss two different topics while the experimenter videotaped the interactions. The participant and confederates were then asked to introduce themselves. Similar to Study 1, confederates indicated that they were the same year as the participant, but lived in a different residence. During the first interaction, participant and confederates were asked to discuss "what you like to do for fun on weekends," and during the second interaction, to describe their "friendships at Yale." The experimenter remained in the room behind the video monitor throughout the interactions.

Once each interaction began, confederates used the techniques described in Experiment 1 to exclude the participant. If the participant appeared to be disengaging from the conversation (e.g. few attempts to enter the conversation), efforts were made to keep the participant involved by either the experimenter or the confederates. Each discussion segment lasted 15 minutes, including the interaction and BP, saliva, and affect sampling. In order to obtain an immediate posttask BP measure, confederates remained in the room for the BP reading. They were led to separate chambers before saliva and affect sampling. When separated from the confederates, the participant was also asked to complete the BSPQ for each confederate. Between the first and second interactions, confederates viewed the participant's BSPQ forms to assess the effectiveness of their exclusion. If the participant rated either confederate positively, confederates increased the intensity and frequency of the exclusion techniques.

For the recovery period, participants completed more questionnaires while listening to soft, classical music. Two saliva, blood pressure, and affect measures were obtained during the recovery period. Debriefing involving both the participant and the confederates followed.

Measures

Self-Reported Affect: Self-reported affect was assessed at five points during the stress session. Participants rated 21 randomly ordered mood adjectives on 110-mm visual analogue scales according to how they felt during the period of interest (e.g. during baseline, while completing the first YIPS interaction). Three affect scales (tension, positive affect, and negative affect) were created from a principal components analysis of the 21 adjectives. The tension scale included the items tense, defeated, stressed, challenged, powerless, hopeless, worthless, anxious, distressed, and out of control. The positive affect scale included the items energetic, happy, relaxed, and alert; and the negative affect scale included depressed, sad, angry, and fatigued. All scales showed

good internal consistency (Cronbach's alphas were .94, .87, and .80, respectively).

Bogus Social Perceptions Questionnaire: The BSPQ (34) was in the format described in Experiment 1. It was completed by the participants after each YIPS interaction to increase the legitimacy of the cover story. Participants were not shown precompleted bogus forms from the other participants, as we believed a more prolonged stressor, rather than an acute interpersonal insult, was necessary to influence physiological outcomes.

Salivary Cortisol Measures

Salivary cortisol is considered to be a reliable and valid indicator of unbound or free cortisol levels in plasma (41,42). Six saliva samples were taken from each participant over the course of the stress session using the Salivette sampling device (Sarstedt, Rommelsdorf, Germany). Cortisol samples were analyzed in duplicate by the General Clinical Research Center at the Yale School of Medicine by radioimmunoassay (Diagnostic Products Corporation, Los Angeles, CA). Intra-assay and inter-assay coefficients of variation ranged from 6%–16%.

Blood Pressure Measures

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were assessed using an Omron Auto-Inflation digital sphygmomanometer (model HEM-706) at six points during the YIPS session.

Data Analyses

Multivariate and univariate repeated measures analyses of variance (MANOVAs and ANOVAs) were conducted to assess changes in affect and physiological measures following the YIPS. For physiological measures, follow-up analyses involved paired contrasts comparing each time point with baseline levels. To examine sex differences in BP and cortisol responses over time, repeated measures analyses of covariance (ANCOVAs) were conducted. Huynh–Feldt corrections were applied when appropriate for all repeated measures analyses (43). ANCOVA covariates included baseline levels (44), BMI, and age. For BP, significant sex differences were followed by one-way ANCOVAs on change scores following each YIPS challenge. Change scores were obtained by subtracting posttask measures from the mean of the two baseline measures (45). For cortisol, follow-up analyses involved Dunnett's one-tailed *t*-tests to assess for predicted sex differences in means at each time point (46).

As cortisol values tended to be positively skewed, analyses were based on the natural logarithms of the cortisol values. However, nontransformed values are reported in all tables and figures. All effect sizes were again calculated using the formula ($r = F/F + df_{error}$) (39). Effect sizes and percentage change were based on differences between baseline and the second interaction for affect measures and between baseline and peak levels for BP and cortisol. BSPQ analyses involved X^2 tests comparing observed frequencies to those expected by chance.

RESULTS

Changes in Self-Reported Affect Between Baseline and YIPS Interactions

To assess change in affect following the YIPS, we conducted a one-way repeated measures MANOVA followed by three univariate ANOVAs with the three affect scales (tension, negative affect [NA], and positive affect [PA]) as DVs and three time points (baseline, post-YIPS interaction 1, post-YIPS interaction 2) as repeated measures. Mean ratings from the tension, PA, and NA scales following baseline and the two YIPS challenges are presented in Table 1. Significant multivariate changes in affect between baseline and the two challenges emerged, Wilks' Lambda = .61, $F(6, 92) = 4.83$, $p < .001$. Participants were significantly more tense and showed lower levels of PA during both of the interpersonal challenges compared to baseline, univariate Fs(2, 48) = 7.95 and 8.55, respectively, ps $< .001$. Following both YIPS challenges, mean tension increased by approximately 90% and PA decreased by approximately 24%. Effect sizes were .52 and .62, respectively. Although participants showed somewhat greater NA during the interpersonal challenges than at baseline (mean NA increased by approximately 40%), this difference was not significant, $F(2, 48) = 1.81$. Effect size was .32.

TABLE 1
Mean Affect and Blood Pressure Ratings During Baseline, Stress, and Recovery Periods

Self-Reported Affect Scale	Baseline *M* (*SD*)	Challenge 1 *M* (*SD*)	Challenge 2 *M* (*SD*)
Tension	10.22[a] (8.60)	19.40[b] (18.06)	18.82[b] (16.65)
Positive Affect	45.78[b] (18.53)	37.19[a] (20.80)	34.70[a] (19.06)
Negative Affect	15.24 (9.13)	19.39 (21.03)	21.39 (20.41)

Note: Means within a row that differ significantly ($p < .05$) by planned contrasts are designated by different superscripts. Values represent mm along a 110 mm visual analogue scale.

Bogus Social Perceptions Questionnaire

After the first challenge, 88% of the participants indicated that at least one confederate would not be in their social circle; 80% were not interested in getting to know at least one of the confederates better, for both confederates pooled, $X^2(2) = 16.88$ and 8.00, respectively, ps $< .05$. Following the second conversation, 96% of the participants reported that at least one confederate would not be in their social circle, 84% preferred not to get to know at least one confederate better, and 80% preferred that both confederates be kept as acquaintances, $X^2(2) = 29.12$, 16.88, and 25.04, ps $< .001$.

Changes in SBP, DBP, and Salivary Cortisol During Baseline, YIPS, and Recovery

To examine changes in SBP, DBP, and cortisol over the six time points (two measures as baseline, one following each interaction, and two during recovery), we conducted a 2 (sex) × 6 (time), repeated measures MANOVA followed by three 2 × 6 repeated measures ANOVAs. Mean SBP, DBP, and cortisol levels for males and females are presented in Table 2. Significant multivariate changes in physiological measures over the course of the YIPS session emerged, Wilks' Lambda = .66, $F(15, 257) = 2.74$, $p < .001$. Univariate ANOVAs also revealed significant changes over time for SBP and DBP, Fs(5, 115) = 4.54 and 5.74, respectively, ps $< .005$, with significant increases from baseline following each interaction and during both recovery points for both SBP and DBP (all ps $< .05$ by paired contrast). Average SBP and DBP increases from baseline to peak were 10 and 7 mm Hg, respectively, resulting in effect sizes of .83 and .79. Although mean peak cortisol levels showed an 85% increase over baseline (from .14 to .26 μg/dl), changes in cortisol over time were not statistically significant, for six time points, $F(5, 105) = 0.93$; between baseline and peak, $F(1, 24) = 3.58$, $p < .10$. Effect size was .36.

TABLE 2
Mean SBP, DBP, and Cortisol Levels During Baseline, Stress, and Recovery Periods by Sex

	Systolic Blood Pressure (mm Hg)		Diastolic Blood Pressure (mm Hg)		Salivary Cortisol (μg/dl)	
	Males $n = 13$	Females $n = 11$	Males $n = 13$	Females $n = 11$	Males $n = 12$	Females $n = 10$
Baseline 1						
Mean	107.77[a]*	88.82[a]*	59.92[a]	57.36[a]	.14[ab]	.14
SD	9.93	4.14	4.35	3.41	.06	.07
Baseline 2						
Mean	106.62[a]*	90.09[ab]*	62.23[abc]	59.18[ab]	.14[ab]	.14
SD	7.27	6.00	9.87	5.36	.08	.08
Challenge 1						
Mean	114.08[b]*	95.27[bc]*	66.46[c]	62.45[bc]	.14[ab]	.14
SD	12.09	9.19	8.28	5.37	.07	.09
Challenge 2						
Mean	110.77[ab]*	100.00[d]*	65.31[c]	65.27[c]	.16[b]	.30
SD	15.96	8.64	8.30	4.90	.07	.54
Recovery 1						
Mean	109.00[a]*	98.55[cd]*	64.77[bc]	62.67[bc]	.13[ab]*	.22*
SD	12.42	15.15	8.05	4.46	.06	.14
Recovery 2						
Mean	109.38[a]*	94.73[bc]*	61.62[ab]	60.82[ab]	.11[a]	.27
SD	12.14	3.93	7.74	4.77	.06	.40

Note: Within a column, means that differ significantly ($p < .05$) by paired contrast from one another are designated by different lettered superscripts. Significant sex differences ($p < .05$ by Dunnett's *t*-test) for a given measure are indicated by asterices (*'s).

Sex Differences in SBP, DBP, and Salivary Cortisol Following the YIPS Challenges

As even nonsignificant differences in baseline levels may influence reactivity (54), sex differences in BP and cortisol changes over the YIPS session were examined through a series of 2 (sex) × 6 (time) ANCOVAs with baseline levels as well as BMI and age as covariates. Significant sex *x* time interactions emerged for SBP and cortisol, $F(5, 95) = 2.85$, $p < .05$, and $F(5, 85) = 2.64$, $p < .05$, respectively, but not for DBP, $F(5, 95) = 0.84$. Figure 2 illustrates sex differences in SBP reactivity to each YIPS challenge. Although males showed greater SBP at all time points, $ts(19) > 2.09$, $ps > .05$, females showed significantly greater increases in SBP after both YIPS challenges than males, $F(1, 20) = 15.61$, $p < .001$ for change score comparisons, and somewhat but not significantly greater SBP reactivity following the first YIPS challenge, $F(1, 20) = 1.37$. Controlling for baseline SBP, BMI, and age, females' mean SBP levels increased by 19 mm Hg after both interactions compared to a 5 mm Hg decrease in SBP for males. Raw baseline to peak differences were approximately 11 mm Hg compared to 7 mm Hg for males.

Figure 3 shows sex differences in salivary cortisol over the course of the stress session. Women demonstrated greater cortisol levels at all time points following the YIPS challenges, with significantly greater levels after the first recovery period, Dunnett's $t(17) > 1.74$, $p < .05$, one-tailed. Females' peak cortisol levels increased by 150% from baseline (from .14 to .35 μg/dl), while males' peak levels increased by only 14% (from .14 to .16 μg/dl).

DISCUSSION

In this article, we introduced the Yale Interpersonal Stressor, a live interpersonal interaction stressor designed for use with undergraduates. The YIPS is a rejection paradigm involving one or two interactions with two same-sex confederates who actively exclude the participant using verbal and nonverbal cues. The YIPS offers several innovations compared to previous laboratory stressors. First, it includes live social interactions as the primary means for inducing distress; second, it involves challenges built around social topics; and third, it does not require participants to have a long-term partner. Given the dearth of nonagentic, interpersonal stressors in the literature, we hope the YIPS will serve as a useful tool for elucidating pathways between interpersonal functioning and health.

We presented two studies in which the YIPS was found to be effective in changing affect, eating behavior, and physiological measures. In both studies, the YIPS induced significant increases in negative affect (28%–90%) and decreases in positive affect (21%–24%) compared to baseline or a control condition. Such moderate to large effects (effect sizes ranging from .32–.62) were comparable to other laboratory stressors in the literature, particularly those posited to be interpersonal in nature (typical effect sizes range from .12–.52) (14,15,32,47). The YIPS also induced significant changes in physiological measures. Peak blood pressure increases ranged from 7–10 mm Hg for both men and women, and were as high as 19 mm Hg for women controlling for baseline levels, age, and body mass index. Such increases are consistent with some previous stressors in the literature (12,29,48,49), but slightly lower than others (19,28). However, since BP was measured immediately following rather than during the YIPS interactions, it is possible that during-task BP measures would have shown increases similar to even the larger BP increases from previous studies. For salivary cortisol, the YIPS induced 85% increases in cortisol overall compared to baseline, with a 150% increase for women. This change is consistent with other studies that found increases of 60%–100% (50), 1–4-fold changes (16,51), and decreases from baseline (52) following interpersonal distress. However, although we included a logarithmic transformation of the cortisol values, because our sample size was small, we cannot rule out the possibility that females' greater reactivity was influenced by outliers.

The YIPS also affected eating behavior. In particular, restrained eaters ate twice the amount of ice cream eaten by unrestrained eaters following the YIPS, a difference of similar magnitude to those found in previous studies (e.g. 15). Although consistent with other studies in which restrained eaters ate more than unrestrained eaters after social comparison (32) and ego-related challenges (15), our results should be interpreted with caution as they emerged from exploratory, albeit conservative, analyses. Further studies with larger *ns* and greater power may lead to more definitive conclusions regarding the effects of the YIPS on eating behavior as well as other behaviors (e.g. smoking, alcohol use, academic performance).

As predicted, females showed significantly greater increases in SBP and cortisol following the YIPS than did males. As most studies of physiological responses to agentic stress have found greater increases in men (50,51,53), the present findings emphasize the importance of interpersonal or communal concerns for women and suggest that this and other interpersonal stressors may be particularly useful for studying disorders with a greater prevalence among women (e.g. eating disorders and depression) (54,55). Males' attenuated physiological reactivity to the YIPS may indicate that men are physiologically less vulnerable to interpersonal stress and perhaps that interpersonal stressors are less effective for males. Further research is warranted to replicate these effects with

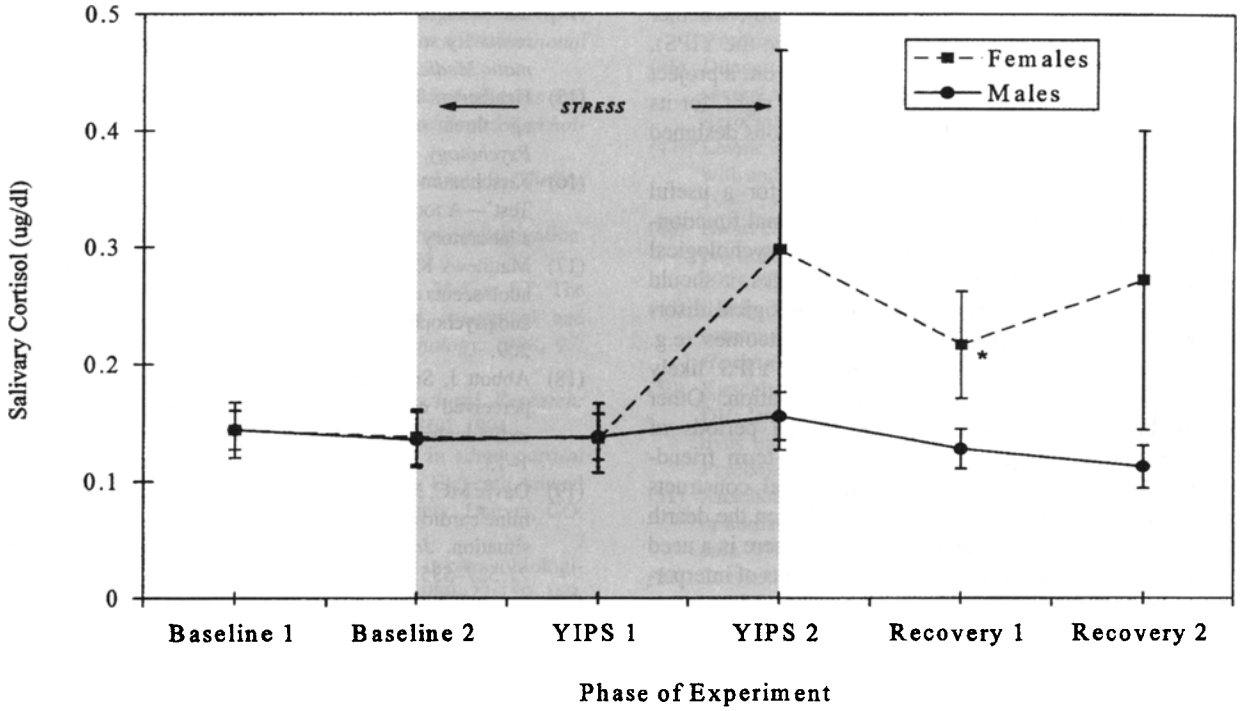

FIGURE 3: Salivary cortisol levels (means ± SEM) during baseline, stress (2 YIPS interactions), and recovery periods for males and females. Salivary cortisol was sampled at six time points: 10 minutes before the onset of the stress period (*Baseline 1*), immediately prior to the stress period (*Baseline 2*), after the first YIPS challenge (*YIPS 1*), following the second YIPS challenge (*YIPS 2*), 15 minutes following the end of the YIPS challenges (*Recovery 1*), and 30 minutes following the end of the YIPS challenges (*Recovery 2*). Duration of the stress period is highlighted in gray. Differences between men and women significant at the $p < .05$ level by Dunnett's *t*-test are indicated with a *. *Note:* A 20-minute lag in cortisol increase following the onset of stress is typical.

a larger sample of men and to examine whether sex differences from the YIPS generalize beyond rejection stress and marital conflict stressors (26,27).

The YIPS was designed to be similar to the experience of exclusion from a conversation (30,31), or failing at attempts to befriend other individuals. We chose discussion topics that were highly social in nature (e.g. discussing how one makes friends and gets to know people). That most participants preferred not to be friendly with either confederate following the interactions suggests that YIPS significantly affected interpersonal perceptions. Further, a preliminary study suggested that the YIPS was perceived as significantly more interpersonal and social and as involving more exclusion and rejection than an agentic stressor (math and verbal challenges with time pressure). However, as we did not assess study participants' perceptions of the interpersonal nature of the YIPS, we recommend further research to explicitly compare both perceptions of and responses to the YIPS with typical laboratory stressors.

Although we believe the YIPS is a promising paradigm for clarifying pathways between interpersonal functioning and health, there are several limitations to the two studies reported here. Most importantly, both studies included small sample sizes, and thus low power. Low power along with high individual variability may explain why moderate to large effect sizes did not reach significance in several analyses (e.g. eating, overall cortisol increases). Clearly, more highly powered studies are warranted to validate this paradigm and replicate these effects. Second, with respect to the physiological measures, we can not rule out the possibility that changes following the YIPS were due to increased activity (talking) during the YIPS compared to the baseline and recovery periods. However, changes in affect, participants' negative perceptions of the confederates, and prior studies suggesting that cortisol increases occur independent of activity (e.g. 56) argue against this possibility. Again, further research comparing responses to the YIPS with positive social interactions or speaking aloud will be important to rule out this confound. Sex differences in physiological responses may also reflect differences in activity between men and women. Perhaps men withdrew more from the interactions than did women, as has been shown in the marital conflict literature (27). Future studies might examine mechanisms underlying sex differences in responses to the YIPS. Third, as both studies reported here involved only undergraduates, it is not clear whether the YIPS might be appropriate for other populations. Although developed and validated for use with college students, we believe the YIPS may also be appropriate for adults and pediatric populations. Most critical for generalizing the YIPS to other populations would be for confederates to have a number of demographic commonalities (e.g. age, grade level, gender, marital status, job) with participants. Topics could also be varied to be age and population appropriate (e.g. marital issues, after-school activities). More interactions may be required for physiological changes, but fewer may be necessary to change affect or influence behavior.

Finally, attention to ethical concerns is critical when the YIPS is used. As the paradigm is designed to induce exclusion and rejection and involves deception, great care should be taken in debriefing. We found debriefing to be most effective when it included a complete explanation for the necessity of deception along with reassurance that the rejection was not personal, but rather, that confederates were trained to exclude participants. Further, as confederates, too, may experience distress from the YIPS, we recommend including both confederates and participants in debriefing. Finally, although distressing, exclusion and rejection

are experienced ubiquitously and at all life stages (30), whether involving rejection by two potential new friends (as in the YIPS), silent treatment from an angry spouse, or exclusion from a project at work. As such, it is deserving of study in its own right, for its potential impact on health, and in order that interventions designed to reduce rejection distress may be developed.

In sum, we presented preliminary validation for a useful paradigm for clarifying pathways between interpersonal functioning and disease. As the YIPS resulted in significant psychological and behavioral effects as well as physiological changes, it should be appropriate for researchers investigating psychological disorders (e.g. eating disorders) and physical health outcomes (e.g. cardiovascular disease). As described herein, the YIPS likely simulates the primary stages of friendship formation. Other stressors may be developed to address additional periods of relationship development (e.g. functioning in long-term friendships, sibling relationships) and other interpersonal constructs besides rejection (e.g. anger, frustration) (28,29). Given the dearth of live, social stressors in the literature, we believe there is a need for more such stressors addressing different components of interpersonal functioning. Further, richer theoretical models of interpersonal constructs (e.g. 20,30) need to be developed and applied to reactivity investigations. Only then can we discern which components of interpersonal distress (e.g. rejection, withdrawal, disagreement) are most important for physiological reactivity and health.

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