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Emily R. Anderson
University of Nebraska-Lincoln

Debra A. Hope
University of Nebraska-Lincoln, dhope1@unl.edu

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The Relationship Among Social Phobia, Objective and Perceived Physiological Reactivity, and Anxiety Sensitivity in an Adolescent Population

Emily R. Anderson, M.A. and **Debra A. Hope, Ph.D.**
University of Nebraska-Lincoln

Abstract

Physiological theories may be important in the development and maintenance of social phobia in youth. A limited literature base indicates that youth with social phobia experience increases in objective physiological arousal during social-evaluative situations and are more aware of such increases compared to nonanxious youth. Recent research suggests that youth with social phobia also evidence heightened levels of anxiety sensitivity, which may lead to interpretation of physiological arousal as dangerous or distressing, and, as a result, in avoidance of situations which produce increased physiological arousal. The purpose of the current study was to examine interaction among objective physiological arousal, perceived physiological arousal, and anxiety sensitivity among adolescents diagnosed with social phobia. A sample of community adolescents participated in two anxiety-provoking tasks during which objective physiological arousal was monitored, and after which perceived physiological arousal and anxiety sensitivity were evaluated. Results from this study evidenced no differences between social phobic and nonanxious adolescents with regard to objective physiological arousal during either anxiety-provoking tasks. Adolescents with social phobia, however, were more aware of measured increases in physiological arousal, as well as more afraid of the potential social implications of that arousal compared to nonanxious adolescents. Implications for theory and treatment are discussed.

Keywords

social phobia; adolescence; physiological reactivity; anxiety sensitivity

Social phobia has been one of the least researched and least recognized disorders in adolescence, despite its high prevalence rate in this population (Kashdan & Herbert; 2001). Social phobia is defined as a "marked and persistent fear of one or more social or performance situations in which the person is exposed to unfamiliar people or to possible scrutiny by others" (DSM-IV; American Psychological Association, 1994, p. 416). Research has suggested that the average age of onset for social phobia occurs in early to mid-adolescence (Albano & Detweiler, 2001; Beidel, 1998; Beidel & Randall, 1994), and prevalence rates in childhood and adolescence average around 1%, with a lifetime prevalence rate of approximately 5-15% (Kashdan & Herbert, 2001; Kendall & Warman, 1996).

Requests for reprints should be sent to: Emily R. Anderson, University of Nebraska-Lincoln, Department of Psychology, 238 Burnett Hall, Lincoln, NE 68588-0308, Telephone: 402-472-7789, Fax: 402-472-4637, Email: anderso1978@yahoo.com.

Researchers have proposed a number of theories examining factors associated with the development and maintenance of social phobia, but recently there has been a proliferation of physiological theories. Such theories suggest that individuals with social phobia experience heightened physiological arousal when they enter social situations, which they interpret as an indication of danger or anxiety (Gerlach, Mourlane, & Rist, 2004). Social phobic individuals report, furthermore, that such an interpretation of physiological arousal leads to increased symptoms of anxiety such as a racing heart, or blushing (Mauss, Wilhelm, & Gross, 2003). Physiological arousal, thus, may play an important role in the development of fear in social situations if individuals perceive physiological symptoms in social situations as dangerous. Perceptions about the dangerousness of such physiological arousal, furthermore, may maintain symptoms of social phobia as individuals learn to avoid social situations in order to evade such physiological arousal.

The extent to which individuals with social phobia experience higher levels of physiological arousal in social-evaluative situations compared to nonanxious individuals remains somewhat unclear. Most research regarding the role of physiological reactivity in social phobia has been conducted with adult samples. Some research has found differences in physiological arousal, as measured by heart rate and blood pressure, such that socially anxious and social phobic individuals exhibit higher arousal compared to nonanxious individuals (i.e., Beidel, Turner, and Dancu, 1985; Eckman & Shean, 1997). Other studies, however, have failed to differentiate socially anxious and nonanxious adults with regard to physiological arousal (i.e., Edelmann & Baker, 2002; Hofmann, Newman, Ehlers, & Roth, 1995).

There are several possible explanations for apparent inconsistencies in previous research with regard to the relationship between physiological arousal and social phobia. First, many of these investigations have small sample sizes and limited power for statistical analyses. Second, the nature of anxiety-provoking tasks differs across studies. Some investigations used an impromptu speech to evoke anxiety, but others used conversation tasks, digit recall tasks, and tasks of viewing of anxiety-provoking videos, which may have produced differential levels of physiological arousal. Third, baseline and task period measurements were as short as three minutes in some investigations, and as long as ten minutes in other investigations, and thus the duration of some tasks may not have been long enough to produce physiological arousal. Lastly, postural changes may have lead to inconsistencies in physiological arousal because few investigations reported whether or not participants were seated or standing during measurement periods.

Although there is a large literature on physiological arousal in adults, only three studies have investigated this construct in youth. All three studies found that youth with social anxiety (Matthews, Manuck, & Saab, 1986) or test anxiety (Beidel, 1988; 1991) evidenced higher heart rates compared to nonanxious adolescents during oral speeches and oral reading sessions. Differences with regard to blood pressure, however, were equivocal. Two studies found evidence for higher blood pressure in test-anxious and socially anxious youth (Beidel, 1991; Matthews et al., 1986), although the latter study found elevated systolic blood pressure, but not diastolic blood pressure. One study found no difference in blood pressure between test-anxious children and nonanxious children during anxiety-provoking tasks (Beidel, 1988). Taken together, these investigations suggest that socially anxious youth evidence elevated heart rates compared to nonanxious adolescents in social evaluative situations, but the evidence with regard to blood pressure is mixed.

Because socially anxious individuals fear that their physiological arousal will be visible to others (McEwan & Devins, 1983), perceived levels of physiological arousal may be more important than objective physiological arousal. As yet, though, no studies have investigated the relationship between perceived and objective physiological arousal in youth with social

phobia. Several researchers found evidence for a misperception of physiological arousal among adults with social phobia, such that these individuals report higher physiological arousal compared to nonanxious individuals, although objectively they are not more physiologically aroused (Edelmann & Baker, 2002; Mauss, Wilhelm, & Gross, 2004). Mauss and colleagues, in fact, found only low to moderate correlations between objective and perceived physiological arousal during social-evaluative situations. One explanation for this misperception of physiological arousal is that social phobic individuals may exhibit more self-focused attention, and, thus, may be more aware of any increases in physiological arousal than non-socially anxious individuals in anxiety-provoking situations (Gerlach et al., 2004). Such increased awareness may then lead to greater reports of physiological arousal in socially phobic individuals despite the absence of objective differences compared to nonanxious counterparts.

In addition to being more aware of physiological arousal, individuals with social phobia also may perceive physiological arousal as a visible indication of their anxiety and as a potential source of embarrassment, which is related to the construct of anxiety sensitivity. Anxiety sensitivity has been defined as a belief that physical sensations associated with anxiety will lead to catastrophic outcomes, such as dangerous physical symptoms or social embarrassment (Walsh, Stewart, McLaughlin, & Comeau, 2004). Initial support has been garnered for a relationship between anxiety sensitivity and social anxiety symptoms in adults (Barlow, 2002; Muris, Schmidt, Merckelbach, & Schouten, 2001) and in a sample of adolescents, such that socially anxious adolescents exhibited higher levels of anxiety sensitivity compared to nonanxious adolescents (Eley, Stirling, Ehlers, Gregory, & Clark, 2004). More research, however, is needed to elucidate the relationship between anxiety sensitivity and social phobia in youth.

Taken together, physiological theories and previous research suggest there are several factors that likely play a causal role in the development and maintenance of social phobia in youth. First, social phobic youth experience heightened physiological arousal in social-evaluative situations compared to nonanxious youth. Second, extrapolating from the adult literature, due to lack of research with youth, social phobic youth are likely more aware of increases in physiological arousal due to higher levels of self-focused attention. Third, a limited research base indicates that social phobic youth experience heightened levels of anxiety sensitivity, which leads them to interpret physiological arousal as a potential source of social embarrassment, and thus may lead these individuals to avoid social-evaluative situations which produce this increased physiological arousal.

The goal of the present study was to investigate the role of objective physiological arousal, perceived physiological arousal, and anxiety sensitivity in an adolescent population, some of whom have diagnoses of social phobia. It was hypothesized that the social phobic adolescents would exhibit greater increases in heart rate and blood pressure, compared to nonanxious adolescents, during two anxiety-provoking tasks. It also was hypothesized that social phobic adolescents would evidence higher levels of perceived physiological arousal, as well as higher levels of anxiety sensitivity, compared to nonanxious adolescents.

As noted, prior research investigating differences in physiological arousal between social phobic and nonanxious participants have been fraught with methodological limitations. This investigation improves upon these earlier studies in several ways. First, the sample consists of 392 adolescents (85 with social phobia), and thus, should be of sufficient size to detect differences between the groups. Second, two anxiety-provoking tasks were used and the duration of each was 10-minutes in an attempt to ensure that the tasks were sufficiently anxiety-provoking. Third, participants were required to stand throughout the baseline periods and during both anxiety-provoking tasks when physiological recordings were taken so that postural changes did not impact measurements.

Method

Participants

Three hundred and ninety-two adolescents recruited from local public schools in a small Midwestern city served as participants in the present study. The sample included 179 boys and 213 girls between the ages of 13 and 17 (*M* age = 14.5, *SD* = 1.27). With respect to ethnic background, the breakdown was representative of the larger community as 92% of the sample was European American, 3% was African American, 3% was Asian American, 1% was Hispanic, and 1% was Biracial. Participants in the study reported various socioeconomic statuses, with a specific breakdown as follows: family income less than $10,000 (2%), $11,000 to $25,000 (9%), $26,000 to $50,000 (24%), $51,000 to $75,000 (25%), $76,000 to $100,000 (22%), and greater than $100,000 (17%).

Measures

Anxiety Disorders Interview Schedule for DSM-IV: Child/Parent Version (ADIS-IV:C/P; Silverman & Albano, 1996). The ADIS-IV:C/P (hereafter referred to as the ADIS) is a semi-structured diagnostic interview that is administered separately to the adolescent and his/her parent. The ADIS is organized diagnostically according to DSM-IV anxiety disorders, and additionally assesses dysthymia and major depression, attention deficit-hyperactivity disorder, conduct disorder, and oppositional-defiant disorder. Each diagnosis is augmented with a clinician's severity rating (CSR) which is based on impairment in functioning and the severity of symptoms. The CSRs range from 0 (none) to 8 (very severely disturbing/disabling), and a minimum rating of four is required to make a diagnosis. The ADIS provides separate diagnoses and CSRs based on the adolescent and parent interview. A composite diagnosis is then made based on both the adolescent and parent interviews and includes diagnoses from both adolescent and parent interview, with the higher of the two CSRs if both interviews result in the same diagnosis. The ADIS was included in the present study to form diagnostic groups and diagnoses used in the current study were based on composite diagnoses from both the parent and adolescent interviews. Previous research has found the ADIS to be a reliable and valid measure of anxiety disorders in youth (Silverman & Eisen, 1992; Silverman & Rabian, 1995).

All of the diagnostic interviews were completed by trained doctoral-level clinical graduate students. All interviewers were trained based on the criteria outlined by authors of the ADIS-IV:C/P (Silverman & Albano, 1996). In order to assess for independent diagnostic agreement, all of the diagnostic interviews were audiotaped. A second trained interviewer randomly selected and re-evaluated 25% of the tapes to assess for interrater reliability. It was considered a diagnostic match if there was exact agreement on the composite diagnoses and CSRs within one point, similar to the interviewer training process. In the present sample, interrater reliability was found to be 94% for composite diagnoses.

Formation of Diagnostic Groups—Two groups were formed using the ADIS: a social phobic group and a nonanxious group. Adolescents who received a primary composite diagnosis of social phobia were included in the social phobic group. This criteria resulted in 85 adolescents (42 males and 43 females) being classified as social phobic. Of this group, 69 participants had a primary diagnosis of social phobia and no other diagnoses, and 15 of these adolescents had another additional anxiety disorder (11 had generalized anxiety disorder, 2 had specific phobia, and 2 had obsessive-compulsive disorder) and 1 had an additional diagnosis of oppositional defiant disorder. It should be noted that primary and additional diagnoses were determined by the CSRs such that the diagnosis with the highest CSR was the primary diagnosis. The nonanxious group included 285 adolescents (132 boys and 153 girls) and consisted of adolescents who did not meet ADIS diagnostic criteria for any disorder. Thus,

22 of the original sample of 392 adolescents were excluded from the analyses due to having primary diagnoses of GAD (*n* = 15), specific phobia (*n* = 4), OCD (*n* = 1), dysthymia (*n* = 1), and conduct disorder (*n* = 1).

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). The BAI is 21-item self-report measure assessing severity of anxiety symptoms. Items are rated on a four-point Likert scale ranging from zero to three. Studies have established four factors, thus yielding four different subscales: neurophysiological symptoms, subjective aspects of anxiety, "panic-like" symptoms, and autonomic aspects of anxiety. Higher scores indicate higher levels of perceived anxiety and perceived physiological arousal. In the present study, the autonomic subscale (items 2, 18, 20, 21) was included as a measure of perceived physiological arousal during two anxiety-provoking tasks. Examples of items on the autonomic subscale include "feeling hot" and "face flushed." Adolescents completed the BAI after each anxiety-provoking task and were instructed to respond to the items on the BAI specific to the symptoms they experienced during the task. The BAI has adequate test-retest reliability (*r* = .75), high internal consistency (*alpha* = .92), and the subscales have good content and construct validity (Beck et al., 1988). In the present study, the autonomic subscale evidenced good internal consistency for the speech (*alpha* = .75) and for the conversation (*alpha* = .69).

Children's Anxiety Sensitivity Index (CASI; Silverman, Fleisig, Rabian, & Peterson, 1991). The CASI is an 18-item self-report measure assessing fear of anxiety-related sensations. Anxiety sensitivity is related to a belief that these sensations will lead to catastrophic outcomes such as physical symptoms or social embarrassment. Items on the CASI are rated on a three-point Likert-type scale. Scores range from 18-54 with higher scores indicating greater anxiety sensitivity, such that the respondent believes experiencing anxiety will result in negative outcomes. An example of an item on the CASI is "it scares me when my heart beats fast." The CASI was included in the present study to assess fear of experiencing anxiety-related symptoms. The CASI has demonstrated high internal consistency (*alpha* = .87) in both clinical and nonclinical samples, good test-retest reliability over two weeks (*r* = .76 to .79), and good construct validity (Silverman et al., 1991). In the present investigation the CASI exhibited high internal consistency (*alpha* = .84).

Social Phobia and Anxiety Scale for Children (SPAI-C; Beidel, Turner, & Morris, 1995). The SPAI-C is an empirically-derived self-report measure that includes 26 items assessing somatic, cognitive, and behavioral symptoms associated with social phobia. Items on the SPAI-C are responded to on a three-point Likert-type scale assessing the frequency of anxious feelings across various situations. The suggested cutoff score to reliably differentiate socially-anxious children from non-socially anxious children is 18 or higher. The SPAI-C was included in the present study as another measure of social phobia symptoms. The SPAI-C has demonstrated good test-retest reliability, good internal consistency, as well as good concurrent, convergent, and discriminant validity (Beidel et al., 1995). In the present investigation the SPAI-C exhibited high internal consistency (*alpha* = .96).

Anxiety-Provoking Tasks—Adolescents participated in two anxiety-provoking tasks, the order of which was counterbalanced across participants. One task was a 10-minute impromptu speech in front of an audience of three (one graduate student and two undergraduate students, one male and one female). The participant was given a list of five possible topics to discuss (i.e., sports, family, hobbies, school, favorite vacation) and three minutes to prepare for the speech. The participant was not allowed to prepare notes. The second task was a 10-minute conversation with an unfamiliar person who appeared to be a same-sex peer (an undergraduate research assistant). We specifically chose young-looking undergraduates who posed as college freshman. If the participant questioned the undergraduate about his/her age, the undergraduate was instructed to say that he/she was 18 years old. The participant was instructed to engage in

conversation with the unfamiliar person until told to stop, and to talk about anything other than the current study. Adolescents were asked to rate their Subjective Units of Distress (SUDS) prior to and after each task, indicating the highest level of anxiety experienced during each task. Physiological measurements were collected before, during and after both tasks as well as during a 10-minute baseline period prior to each task. Participants' heart rate was not measured during the 10 minutes following the first task, but was measured for another 10-minute baseline period prior to the second task. Participants were required to stand beginning with the first baseline assessment and were not allowed to sit down until the end of the second task in an attempt to control for postural changes.

These two anxiety-provoking tasks were chosen specifically because the most commonly endorsed anxiety-provoking social situations in adolescent populations is public speaking (Beidel, 1998; Beidel & Randall, 1994) and unstructured peer interactions (Hofmann et al., 1999), and the most frequently occurring situation is unstructured peer interactions, including informal speaking situations (Beidel & Randall; 1994). Speech and conversation tasks thus are relevant social-evaluative situations for adolescents. Although findings from a study by Hofmann and colleagues suggest that adolescents may habituate to speech tasks because they often are required to give oral speeches in school, other research has found that a speech task produces significant increases in heart rate for a nonclinical sample of adolescents (Steiner, Ryst, Berkowitz, Gschwendt & Koopman, 2002), which suggests that a speech task is anxiety-provoking. Thus, because there is some disagreement about whether unstructured peer interactions or speech tasks are more anxiety-provoking for adolescents, both tasks were included in the present study. In the present study adolescents in the social phobic group reported significantly higher SUDS ratings compared to adolescents in the nonanxious group during the speech (F (1, 345) = 49.92, $p < .001$, $d = .91$), and during the conversation F (1, 344) = 45.15, $p < .001$, $d = .86$), suggesting that tasks elicited social anxiety as expected.

Heart Rate Measurement—Participants' heart rates were monitored at 5-second intervals during both anxiety-provoking tasks (Vantage NV, by Polar Heart Rate Monitors), and for a 10-minute baseline period prior to each task. The participant wore a belt around the chest underneath his/her clothing that transmitted EKG signals to a watch worn around the wrist. After the appointment, the participants' heart rate data was downloaded onto a PC (using the Advantage Interface System, by Polar Heart Rate Monitors) and was then calculated in beats per minute (bpm). Heart rate was then averaged across each minute of the baseline periods and anxiety-provoking tasks. Previous studies have successfully utilized portable heart rate monitors with social phobic participants (i.e., Gerlach, Wilhelm, & Roth, 2003; Grossman, Wilhelm, Kawachi, & Sparrow, 2001; Heimberg, Dodge, Hope, Kennedy, & Zollo, 1990). Reactivity was calculated for the speech and the conversation tasks. Average baseline values were calculated separately for the ten minutes prior to the speech and the conversation. A within subjects ANOVA indicated that average heart rate during the 10 minutes prior to the speech was not significantly different from the average heart rate during the 10 minutes prior to the conversation, F (1, 301) = 2.57, $p > .05$. Change scores were calculated by subtracting average baseline values from minute by minute heart rate measurements during the speech and conversation for each respective task. Thus, positive change scores indicated an increase in heart rate compared to baseline, while negative change scores indicated decreases in heart rate compared to baseline.

Blood Pressure Measurement—Participants' systolic and diastolic blood pressure was measured with an automated digital blood pressure monitor on the non-dominant arm (Model No. UA-767, by A&D Medical; Milpitas, CA). Blood pressure was assessed immediately prior to and following each anxiety-provoking task. Blood pressure has been successfully measured in previous studies with socially anxious adults and children (i.e., Beidel et al., 1985; Beidel, 1988). Reactivity was calculated separately for the speech and the conversation by subtracting

the blood pressure measurements taken before the task from the measurements taken after the task. Thus, positive change scores indicated an increase in blood pressure compared to baseline, while negative change scores indicated decreases in blood pressure compared to baseline.

Procedures

All measures were collected as part of a larger study. Recruitment letters were mailed to parents of adolescents in grades seven through twelve in public middle and high schools. These letters alerted parents and adolescents to a research project focused on adolescents who reported being shy or feeling nervous when in social interactions. The letters indicated that youth who reported such feelings would be compared with those who did not seem to feel nervous in such situations, and thus, any youth between the ages of 13 and 17 may be eligible for participation. Interested parents completed an initial phone screen to determine eligibility for participation. For the purposes of the larger study, adolescents with learning disabilities or previous diagnoses of bipolar disorder, major depressive disorder, attention deficit/hyperactivity disorder, conduct disorder or oppositional defiant disorder were excluded from participation.

Over the course of four years, approximately 9,300 letters were mailed to parents and guardians. Telephone calls requesting additional information about the study were received from approximately 640 parents or adolescents (6.9% of those purportedly receiving flyers). Appointments were scheduled with 475 adolescent/parent pairs (74% of those calling) and 392 adolescent/parent pairs (82.5% of those who had a scheduled appointment) actually attended the assessment appointment.

Adolescents and parents were invited to participate in two, two-hour appointments. Parents and adolescents signed consent and assent forms prior to participating in the study, and a graduate student gave a brief overview of the study. During a first appointment, the ADIS was administered separately to the adolescent and to his/her accompanying parent. Participants also completed a battery of self-report questionnaires, including the CASI and the SPAI-C. Adolescent-parent pairs were compensated $30 for their participation in this appointment.

Participants were then asked to return for a second appointment approximately one week later. Parents and adolescents again signed consent and assent forms prior to participating in the second appointment. During this appointment, the adolescent participated in the two anxiety-provoking tasks described above and heart rate and systolic and diastolic blood pressure was assessed. Subsequent to the anxiety-provoking tasks, the adolescents completed two BAIs, one for the speech and one for the conversation. Participants were compensated $30 for their participation in the second appointment.

Results

Preliminary Analyses

Preliminary analyses were conducted to ensure that the social phobic and nonanxious groups were proportional with regard to demographic variables. Results from the Chi-Square analyses indicated that groups were not significantly different on age (F (1, 368) = .33, $p > .05$), gender ($X^2 = .25$, $p > .05$), race ($X^2 = 2.22$, $p > .05$), or family income ($X^2 = 5.74$, $p > .05$).

Preliminary analyses also were conducted to compare adolescents in the two groups with regard to social anxiety symptomatology, as measured by the SPAI-C. Adolescents in the social phobic group ($M = 21.59$) scored significantly higher than adolescents in the nonanxious group ($M = 10.60$) F (1, 370) = 103.57, $p < .001$, and in fact, scored above the suggested clinical cutoff of 18 to differentiate socially anxious youth from non-socially anxious youth.

Between-Group Differences on Objective Physiological Arousal

To test for possible gender effects, the interaction between gender and diagnosis was examined for all between-group analyses. In order to examine differences between the two diagnostic groups with regard to objective physiological measures, two mixed-group factorial ANOVAs were performed with diagnostic group and gender as between-groups factors and heart rate reactivity for the speech and conversation as the repeated measures variables. A 2 (diagnostic group: social phobic and nonanxious) × 2 (gender) × 10 (heart rate reactivity: mean baseline subtracted from each of the ten minutes) mixed group factorial ANOVA was computed first for the speech. Heart rate data were not included in the analyses if there were three or more data points missing for a particular participant due to equipment malfunction (with the exceptions of those who ended the speech early, whose data were included). For the speech, these guidelines resulted in available data only from 212 nonanxious and 55 social phobic participants. Results indicated that there was a multivariate effect for gender (*Wilks* = .92, F (10, 254) = 2.17, $p < .05$), such that girls exhibited higher heart rate reactivity at each time point during the speech than did boys (all p values < .002; see Figure 1), but this did not vary based on diagnosis. There also was a main effect for time, F (9, 257) = 9.22, $p < .01$. Follow-up LSD analyses, located in Table 1, indicated mean heart rate reactivity at minute one was higher than all subsequent minutes. There was a significant decrease in heart rate reactivity at minute seven and that reactivity did not significantly change over the last three minutes. Results indicated, however, that there was not a multivariate effect for diagnosis (*Wilks* = .95, F (10, 254) = 1.25, $p > .05$) or a multivariate effect for the interaction between diagnostic group and gender (*Wilks* = .96, F (10, 254) = 1.09, $p > .05$). A within subjects ANOVA indicated that average heart rate during minutes two through ten of the speech was significantly higher than the baseline heart rate for the speech, F (1, 318) = 86.70, $p < .001$.

The second 2 (diagnostic group: social phobic and nonanxious) × 2 (gender) × 10 (heart rate reactivity: mean baseline subtracted from each of the ten minutes) mixed group factorial ANOVA was computed for the conversation. For the conversation, heart rate data were available only from 244 non-anxious and 71 social phobic participants. Results indicated that there was a main effect for time, F (9, 305) = 15.32, $p < .01$. Follow-up LSD analyses, located in Table 1, indicated that heart rate reactivity at minute one was significantly higher than all other minutes, and there was no significant difference in heart rate reactivity over all other minutes. There was not a multivariate effect for the interaction between diagnostic group and gender (*Wilks* = .96, F (10, 302) = 1.15, $p > .05$), or for diagnosis (*Wilks* = .97, F (10, 302) = 1.25, $p > .05$), or gender (*Wilks* = .98, F (10, 302) = .68, $p > .05$; see Figure 2). A within subjects ANOVA indicated that average heart rate during minutes two through ten of the conversation was not significantly different than the baseline heart rate for the conversation, F (1, 314) = 1.71, $p > .05$.

To further examine differences between the groups with regard to objective physiological arousal, MANOVAS were computed separately for blood pressure change scores for the speech and conversation. Blood pressure data for the speech were available only for 274 participants (217 nonanxious and 57 social phobic), due to technical problems with the blood pressure cuff. A MANOVA was computed first for the speech using blood pressure reactivity (i.e., change in systolic and diastolic blood pressure measurements from before to after the speech) as the dependent variables, the two diagnostic groups (i.e., social phobic and nonanxious) and gender serving as between-groups factors. Results indicated that there was a main effect for systolic blood pressure F (1, 272) = 42.09, $p < .001$, and for diastolic blood pressure F (1, 272) = 26.46, $p < .001$, such that measurements after the speech were significantly higher than measurements before the speech. Results indicated that there was not a multivariate effect for the interaction of diagnostic group and gender (*Wilks* = 1.00, F (2, 269) = .15, $p > .05$), nor a main effect of

diagnostic group (*Wilks* = .99, *F* (2, 269) = 1.59, *p* > .05) or gender (*Wilks* = .99, *F* (2, 269) = 1.36, *p* > .05).

Another MANOVA was computed for the conversation using blood pressure reactivity (i.e., change in systolic and diastolic blood pressure measurements from before to after the conversation) as the dependent variables, and the two diagnostic groups (i.e., social phobic and nonanxious) and gender serving as between-groups factors. Blood pressure data for the conversation were available only for 271 participants (214 nonanxious and 57 social phobic), due to technical problems with the blood pressure cuff. Results indicated that there was a main effect for systolic blood pressure *F* (1, 272) = 18.54, *p* < .001, and for diastolic blood pressure *F* (1, 272) = 37.36, *p* < .001, such that measurements after the conversation were significantly higher than measurements before the conversation. Results indicated that there was a multivariate effect for gender (*Wilks* = .98, *F* (2, 266) = 3.19, *p* < .05), such that boys had a greater increase in systolic blood pressure compared to girls, but this did not vary based on diagnosis. Results again indicated that there was not a multivariate effect for the interaction of diagnostic group and gender (*Wilks* = 1.00, *F* (2, 269) = .15, *p* > .05) or a main effect of diagnostic group (*Wilks* = 1.00, *F* (2, 266) = .80, *p* > .05). Figure 3 depicts differences in systolic and diastolic blood pressure reactivity for the speech and conversation between social phobic and nonanxious groups, based on gender.

Between-Group Differences on Perceived Physiological Arousal

To investigate differences between the two groups with regard to perceived physiological arousal, a MANOVA was computed using Autonomic subscale scores from the BAI for the speech and conversation as the dependent variables, and the two diagnostic groups and gender serving as between-groups factors. As shown in Table 2, results indicated that there was a multivariate effect for diagnostic group (*Wilks* = .90, *F* (2, 340) = 18.63, *p* < .01). Univariate follow-ups indicated that there was a difference between diagnostic groups on the BAI Autonomic scores for the speech (F (1, 341) = 37.15, p < .001) and for the conversation (F (1, 341) = 24.11, p < .001) such that social phobic adolescents scored significantly higher than nonanxious adolescents (see Table 2). There was not a multivariate effect for the interaction of diagnostic group and gender (*Wilks* = 1.00, *F* (2, 340) = .25, *p* > .05) or a main effect for gender (*Wilks* = 1.00, *F* (2, 340) = .10, *p* > .05).

Between-Group Differences on Anxiety Sensitivity

To investigate differences between the two groups with regard to anxiety sensitivity, an ANOVA was computed using CASI total scores as the dependent variable and the two diagnostic groups and gender serving as between-groups factors. Results indicated that there also was a significant main effect for diagnosis (*F* (1, 359) = 17.32, *p* < .001), such that adolescents with social phobia scored significantly higher on the CASI compared to nonanxious adolescents (see Table 2). There was not a significant main effect for gender (*F* (1, 359) = 3.23, *p* > .05), nor was there a significant interaction between gender and diagnosis (*F* (1, 359) = .23, *p* > .05).

Discussion

The first hypothesis of the current investigation, that adolescents in the social phobic group would evidence greater physiological arousal, as measured by heart rate and blood pressure, than those in the nonanxious group was not supported. Although there were no differences between the groups on heart rate reactivity, both groups experienced a significant increase in heart rate during the first minute of the speech from the baseline, which suggests that the task initially produced heightened physiological arousal for all adolescents. Both groups of adolescents then experienced a significant decrease in heart rate reactivity during the second

minute, and another decrease during minute seven of the speech, which suggests that adolescents experienced more anxiety at the beginning of the speech, but became less anxious as they continued. Although the mean heart rate increase from baseline to the first minute was less than eight beats per minute, and latter differences from baseline decreased to three beats per minute, these differences were significant for the speech. Results were similar for the conversation in that all adolescents experienced increased heart rate during the first minute of the conversation, and then a significant decrease in the second minute, which was maintained over the remainder of the conversation. For this task, the only minute that was not significantly higher than the baseline was minute 2, and some differences from baseline were less than one beat per minute, but were still significant. Although these differences were statistically significant, it is important to keep in mind that some of the increases were fairly small. Additionally, results indicated that although adolescents in the social phobic group did not differ significantly from adolescents in the nonanxious group with regard to blood pressure, all adolescents experienced increases in systolic and diastolic blood pressure during both tasks, which suggests that all adolescents were at least somewhat physiologically aroused. SUDS data for both tasks support that the tasks were sufficiently anxiety-provoking for social phobic youth, but not necessarily for nonanxious youth, who rated their SUDS significantly lower.

Thus, results of the present study do not support previous investigations with youth regarding physiological arousal during anxiety provoking tasks (e.g., Beidel, 1988, 1991; Matthews et al., 1986). It is possible that the discrepant results between the present study and previous studies of physiological arousal in youth are due to several methodological differences. For example, the investigation by Matthews and colleagues utilized an in-vivo task in which adolescents gave a speech in their classrooms in front of their peers, whereas the current study used an analog task with unknown undergraduate confederates. It is possible that adolescents in the present investigation were not as physiologically aroused giving a speech in front of and interacting with unknown confederates, with whom they would not have contact after the study, compared to adolescents giving a speech in front of their peers. Furthermore, the Beidel studies included younger children, whereas the present study utilized adolescents. Lastly, previous investigations did not provide information regarding the conditions under which physiological measurements were taken, such as whether participants were seated or standing, and if these changed from baseline measurements to those taken during the anxiety-provoking tasks. Postural changes thus could have accounted for heightened physiological arousal in previous investigations.

The second hypothesis, that adolescents in the social phobic group would report greater perceived physiological arousal as compared to those in the nonanxious group, was supported in the present study, which is consistent with previous findings (e.g., Mauss et al., 2004). These results suggest that social phobic adolescents were more aware of increases in physiological arousal than their nonanxious peers. However, as noted, although all adolescents experienced significant increases in heart rate and blood pressure, these differences were fairly small, and thus it is likely that social phobic adolescents were really over-reporting physiological arousal, Based on this finding, it is possible that social phobic adolescents exhibit more self-focused attention, which could lead them to be more aware of any increases in heart rate and blood pressure, even though these increases are relatively small and normative during anxiety-provoking tasks. This awareness may, in turn, serve to maintain their anxiety in social situations because this group of adolescents perceives their physiological arousal as indicative of severe anxiety. This is the first study to examine subjective perceptions of physiological arousal in adolescents and, thus, these results suggest that results from the adult research in this area can be extended to adolescents.

Results from this investigation furthermore support the third hypothesis, that social phobic adolescents exhibit higher levels of anxiety sensitivity, and thus are more afraid of experiencing

physiological arousal, compared to their nonanxious counterparts (i.e., Barlow, 2002; Muris et al., 2001). These findings thus extend the research base on anxiety sensitivity to social phobia in adolescence. It seems likely that adolescents in the social phobic group catastrophize about minimal physiological arousal because they are afraid of it. Such adolescents may interpret physiological arousal as a visible indication of their anxiety and as a potential source of social embarrassment.

There were several gender effects observed in the present investigation with regard to objective physiological arousal. Boys evidenced a greater increase in systolic pressure blood pressure compared to girls, whereas girls evidenced higher heart rate reactivity during the speech compared to boys. These observed gender effects, however, did not vary as a function of diagnosis. Two of the previous research investigations specific to youth did not examine gender effects based on physiological arousal. The investigation by Matthews and colleagues (1986), however, found that adolescent boys had higher systolic blood pressure compared to adolescent girls, which is consistent with the results of the present study. As noted in the previous study, though, this apparent difference may be accounted for by differences in body mass. The current investigation found no evidence for differences in perceived physiological arousal between boys and girls, nor did evidence support differences in anxiety sensitivity between boys and girls.

The most important limitation of the current study is its representativeness. The sample was composed of primarily Caucasian, middle class adolescents. Future research should make a concerted effort to include ethnically diverse adolescents to better assess the breadth of applicability of these results. Although the sample was not seeking treatment, a number of adolescents did meet criteria for social phobia and the SPAI-C results indicated that they were clinically severe. This investigation, however, provides an important contribution to the research literature. The results of this study are somewhat novel in that they do not support heightened levels of physiological arousal as being unique to social phobic adolescents, but rather suggest that all adolescents experience some physiological arousal in social-evaluative situations, and that social phobic adolescents are more aware of that arousal, and perceive it as a potential source of social embarrassment, compared to nonanxious adolescents. These findings have important implications for treatment of adolescents with social phobia. If social phobic adolescents are more aware of physiological arousal, and perceive it as an indication of social catastrophe, it is essential that treatment include a psychoeducational component regarding physiological arousal, much like treatment protocols for panic disorder. Current treatments designed specifically for adolescents presenting with social phobia, such as Cognitive Behavioral Group Therapy for Adolescents (Albano, Marten, Holt, Heimberg, & Barlow, 1995) focus on social skills training, cognitive restructuring, and in vivo exposures, and provide limited education about the nature of physiological arousal. It is possible that current treatments may need to more explicitly normalize the experience of physiological arousal during anxiety-provoking social tasks. If adolescents are able to learn that symptoms such as increased heart rate are normative responses to giving a speech or talking to a new person, they may not attribute these symptoms as visible indicators of anxiety which could lead to social embarrassment, which may lessen their anxiety. Furthermore, because adolescents with social phobia seem to be more aware of physiological arousal in social-evaluative situations, they may benefit from learning to focus attention outward, rather than on their internal symptoms, which likely serves to increase their anxiety as well as increase physiological arousal even more. Due to the discrepant findings between the current investigation and previous research regarding objective physiological arousal, more research with adolescents is warranted. Future research also should explore the mechanism by which socially anxious adolescents interpret their physiological arousal. As noted above, self-focused attention may also play a role.

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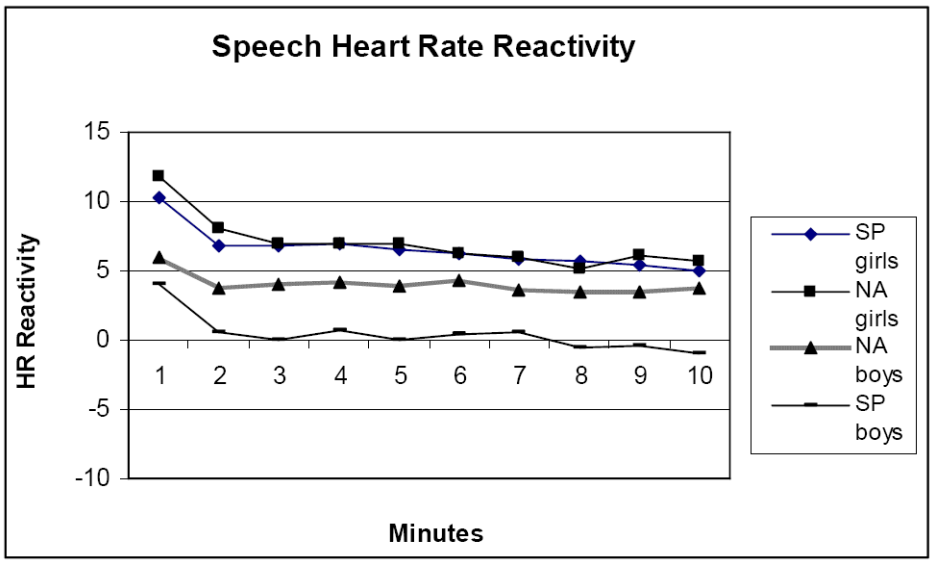

Figure 1.
Heart rate reactivity during the speech for nonanxious (NA) and social phobia (SP) girls and boys.

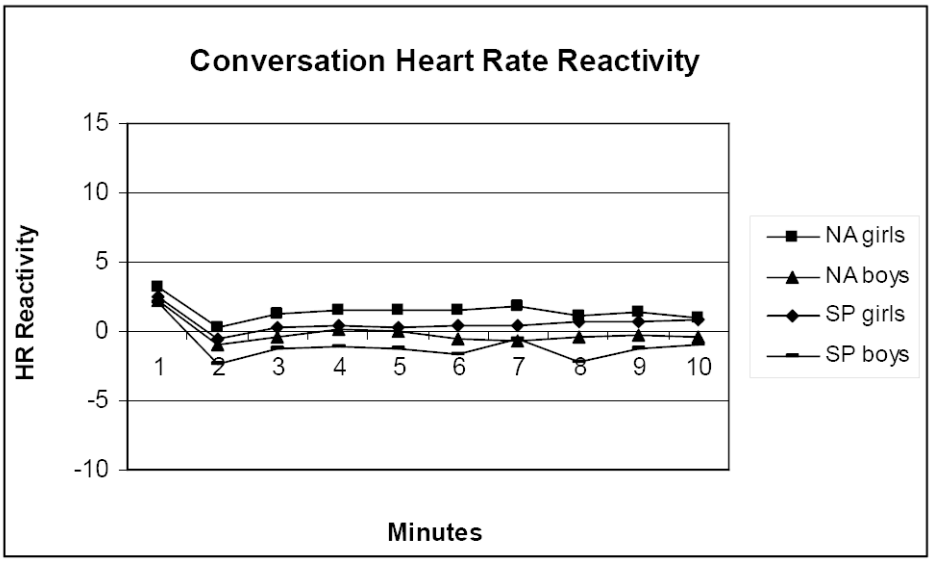

Figure 2.
Heart rate reactivity during the conversation for nonanxious (NA) and social phobia (SP) girls and boys.

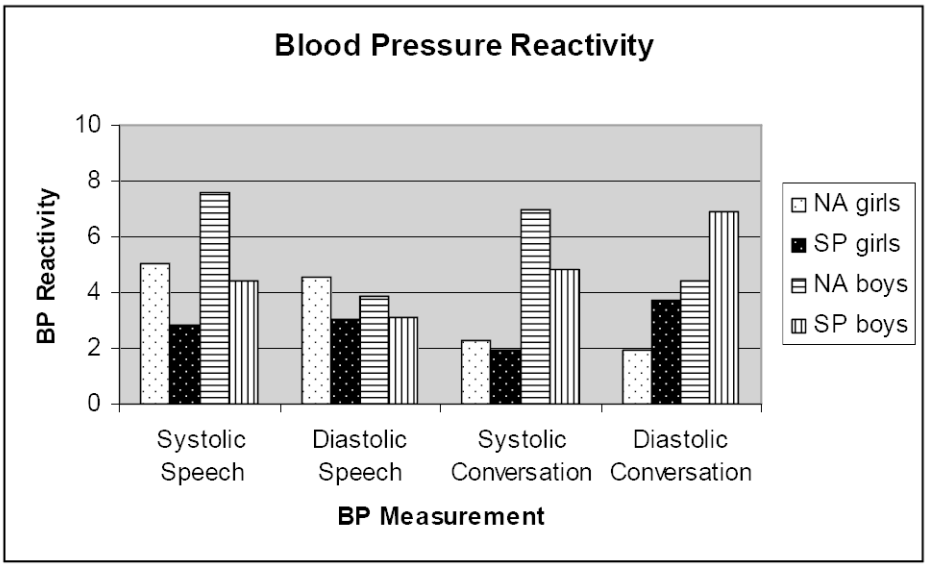

Figure 3.
Systolic and diastolic blood pressure reactivity for the speech and conversation for nonanxious (NA) and social phobia (SP) girls and boys.

Table 1

Mean Heart Rate Change from Baseline across Diagnostic Groups for the Speech and Conversation

Variable	Speech (SD)	Conversation (SD)
HR Min 1	8.30[a] (9.42)	2.74[a] (7.51)
HR Min 2	5.25[b] (8.95)	-.49[b] (6.93)
HR Min 3	5.17[b] (8.56)	.44[b] (6.86)
HR Min 4	5.32[b] (8.49)	.68[b] (6.67)
HR Min 5	5.00[b] (8.39)	.59[b] (6.62)
HR Min 6	5.02[b] (7.93)	.54[b] (6.90)
HR Min 7	4.51[b,c] (7.97)	.73[b] (6.64)
HR Min 8	4.27[c] (8.23)	.41[b] (6.31)
HR Min 9	4.22[c] (8.62)	.67[b] (6.30)
HR Min 10	4.11[c] (8.37)	.54[b] (6.48)

Note: Means with differing superscripts in a column are significantly different from each other for each task.

HR is measured in beats per minute

Table 2

Means and Standard Deviations on Reports of Perceived Physiological Arousal and Anxiety Sensitivity by Diagnostic Group

Variable	Social Phobic	Non-anxious	*F*
	n = 75	n = 270	
BAI Speech-Autonomic	3.91 (2.66)	2.14 (2.05)	37.90**
BAI Conversation-Autonomic	2.88 (2.28)	1.68 (1.72)	24.73**
	n = 84	n = 279	
CASI Total	28.77 (5.30)	26.14 (5.12)	17.32**

** $p < .01$