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Measurement Invariance of the Social Phobia and Anxiety Inventory

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Abstract

The Social Phobia and Anxiety Inventory (SPAI) is a commonly used self-report measure of social phobia that has demonstrated adequate reliability, convergent validity, discriminant validity, and criterion-related validity. However, research has yet to address whether this measure functions equivalently in (a) individuals with and without a diagnosis of social phobia and (b) males and females. Evaluating measurement equivalence is necessary in order to determine that the construct of social anxiety is conceptually understood invariantly across these populations. The results of the current investigation, using a series of nested factorial models proposed by Vandenberg and Lance (2000), provide evidence for strong equivalence across 420 individuals with and without diagnoses of social anxiety disorder and across male and female samples. Accordingly, these results provide psychometric justification for comparison of SPAI scores across the symptom continuum and sexes.

Keywords

social phobia; anxiety; measurement equivalence; invariance

1. Introduction

Social phobia (also known as social anxiety disorder) is characterized by an intense fear and apprehension of social situations in which one might be criticized or evaluated by others (DSM-IV-TR; American Psychiatric Association [APA], 2000). Hallmarks of the disorder include physiological (e.g., palpitations, trembling, muscle tension, sweating, stomachaches, and blushing; Beidel, Turner, & Morris, 1999; Ginsburg, Riddle, & Davies, 2006), cognitive (e.g., rumination and attentional biases; Abbott & Rapee, 2004; Clark & Wells, 1995), as well as behavioral (e.g., escape, avoidance; Beidel, Rao, Scharfstein, Wong, & Alfano, 2010) symptoms. In combination, these symptoms create significant functional impairment (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003; Lecrubier, 1998; Rao et al., 2007;

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Safren, Heimberg, Brown, & Holle, 1996; Stein, Torgrud, & Walker, 2000; Wong, Sarver, & Beidel, 2011) and hinder the development of social skills (Turner, Beidel, Dancu, & Stanley 1989; Beidel et al., 2010).

Social phobia is a prominent public health issue that results in substantial functional impairment. It is the third most common psychiatric disorder in the United States with prevalence ranging from 1–15% of the general population (Costello, Eggar, & Angold, 2004; Costello, Eggar, & Angold, 2005; Grant et al., 2004; Heimberg, Stein, Hiripi, & Kessler, 2000; Kessler, 2003) and 18–32% in clinical populations (Kendall et al., 1997; Weiss & Last, 2001). In addition to the high prevalence of social phobia diagnoses, symptoms of social anxiety that do not meet criteria for social phobia exist among the general population as well (Dell'Osso et al., 2003; Fehm, Beesdo, Jacobi, & Fiedler, 2008; Heiser, Turner, & Beidel, 2003; Heiser, Turner, Beidel, & Roberson-Nay, 2009; Merikangas, Avenevoli, Acharyya, Zhang, & Angst, 2002; Stein, Walker, & Forde, 1996; Stein et al., 2000; Stemberger, Turner, Beidel, & Calhoun, 1995; Turner, Beidel, & Townsley, 1990). These data indicate that, at certain times, between 25.9% (Heiser et al., 2009) and 39% (Stein et al., 2000) of the general population experiences mild to moderate symptoms of social anxiety (e.g., public speaking, job interviews, meeting new people; Stein et al., 1996; Stein et al., 2000) that do not rise to the threshold of a diagnosis (Dell'Osso et al., 2003; Merikangas, 2002; Stein et al., 2000).

One research paradigm used to examine the characteristics of social phobia is to assess individuals with and without symptoms of the disorder (e.g., Beidel et al., 2010; Beidel, Turner, Stanley, & Dancu, 1989; Gamer, Schmukle, Luka-Krausgrill, Egloff, 2008; Osman, Barrios, Aukes, & Osman, 1995; Osman et al., 1996; Roberson-Nay, Strong, Nay, Beidel, & Turner, 2007; Rodebaugh, Chambless, Terrill, Floyd, & Uhde, 2000; Turner, Beidel, et al., 1989). This research is based on the assumption that the measurement of social anxiety is equivalent across those with no disorder and those with social phobia. Assuming measurement equivalence means that (a) items on an inventory hold the same meaning for individuals diagnosed with a disorder as for individuals with no psychiatric diagnosis, (b) numerical ratings used to indicate the severity or frequency symptoms/conditions hold the same meaning for individuals with and without a diagnosis, and (c) the constructs that are represented by the items are perceived similarly across those with and without a diagnosis. When this assumption is violated, between-group comparisons are questionable, and inaccurate statistical and practical inferences may result (Horn & McArdle, 1992; Vandenberg & Lance, 2000).

Similar to the above comparison, assessing measurement equivalence between females and males is equally important because the prevalence of social phobia across sexes has varied. Some data suggest that social phobia presents at higher rates in females compared to males (e.g., 3:2 ratio; Kessler et al., 2005; Mannuzza, Fyer, Liebowitz, & Klein, 1990), while other data suggest equal prevalence for males and females (Bourdon, Boyd, Rae, Burns, & Erbaugh, 1988; Thyer, Parrish, Curtis, Nesse, & Cameron, 1985). In addition to differing prevalence, there is evidence of symptom variation across sexes (e.g., types of feared situations and responses to feared stimuli). Specifically, females with social phobia appear to have more severe fear and avoidance of particular social situations (e.g., speaking with authority figures, presenting in front of an audience or group, working while being observed, being the center of attention, and speaking up at a meeting) whereas males have greater fear and avoidance in other social situations (e.g., using public restrooms, returning goods to a store, and dating situations; Turk et al., 1998; Wittchen, Stein, & Kessler, 1999; Xu et al., 2012). Females also endorse elevated co-morbidity and functional impairment in comparison to males (Yonkers, Dyck, & Keller, 2001), who endorse elevated levels of self-reported embarrassment and less ability to cope in embarrassing social situations

(Edelmann, 1985). Furthermore, females report higher ratings of anxiety both before and during social interaction tasks in comparison to males (Turk et al., 1998). Thus, the current investigation examines measurement equivalence across males and females to determine whether observed sex differences represent true differences or reflect nonequivalence in the measurement process.

There are many available methods by which to assess social phobia symptoms, but self-report instruments remain among the most popular. Initial inventories (e.g., Social Avoidance and Distress scale, Watson & Friend, 1969; Fear of Negative Evaluation Scale, Watson & Friend, 1969; Social Interaction Self-Statement Test, Glass, Merluzzi, Biever, & Larson, 1982; Interaction Anxiousness Scale, Leary, 1983; Fear Questionnaire-Social Phobia Subscale, Marks & Mathews, 1979; Liebowitz Social Anxiety Scale, Liebowitz, 1987; Social Interaction Anxiety Scale, and Social Phobia Scale, Mattick and Clark, 1989) assessed the presence of social distress but often lacked specificity and the ability to discriminate across diagnostic groups (e.g., Turner, McCanna, & Beidel, 1987). To address the limitations of the existing measures, the Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel, et al., 1989; Turner, Beidel, & Dancu, 1996) was designed to assess the broad range of situations associated with social phobia. In addition, because previous instruments were not able to differentiate individuals with social phobia from individuals with agoraphobia, who also endorsed anxiety in social settings but for very different reasons, the SPAI specifically included items to allow for this discrimination. The SPAI includes 45 items rated on a 7-point scale reflecting the frequency of the rater's experiences (i.e., 0 = Never, 1 = Very Infrequent, 2 = Infrequent, 3 = Sometimes, 4 = Frequent, 5 = Very Frequent, 6 = Always). The first 32 items of the SPAI constitute the social phobia subscale and assess cognitive (e.g., "I experience troubling thoughts when I am in a social setting"), physiological (e.g., "I experience [sweating] in a social situation"), affective (e.g., "I feel anxious when making a speech in front of an audience"), and behavioral (e.g., "I feel so anxious in social situations that I leave the social gathering") symptoms. Items are rated for four different populations (strangers, authority figures, opposite sex and people in general). The 13 agoraphobia items are rated using the same 7-point Likert scale. These items assess various anxiety provoking situations which are commonly endorsed by patients diagnosed with agoraphobia (e.g., "I feel anxious when I am on any form of public transportation [i.e., bus, train, airplane]" and "I feel anxious when I am in crowded public places [i.e., stores, church, movies, restaurants, etc.]"). The final score for the SPAI (known as the difference score) is derived by subtracting the agoraphobia subscale total from the social phobia subscale total. This difference score provides a more pure measure of social phobia (Turner, Beidel et al., 1989; Turner et al., 1996).

The SPAI has been the subject of extensive psychometric testing including normative data (Gillis, Haaga, & Ford, 1995; Turner, Beidel, et al., 1989), reliability (Turner, Beidel, et al., 1989), convergent validity (Herbert, Bellack, & Hope, 1991; Osman et al., 1995; Osman et al., 1996), construct validity (Turner, Stanley, Beidel, & Bond, 1989), discriminant validity (Beidel, Borden, Turner, & Jacob, 1989; Peters, 2000; Osman et al., 1995; Osman et al., 1996; Rodebaugh et al., 2000; Turner, Beidel, et al., 1989), and robust prediction of social phobia symptoms and diagnosis (Beidel, Borden, et al., 1989; Beidel, Turner, et al., 1989; Rodebaugh et al., 2000; Herbert et al., 1991).

Although the SPAI was developed with an emphasis on two dimensions (i.e., social phobia and agoraphobia; Turner, Beidel, et al., 1989), the 32-item social phobia subscale has also been the subject of factor analyses. The result of these investigations typically revealed the existence of five factors (i.e., related to individual interactions, cognitive and somatic complaints, group interactions, avoidance, and being the focus of attention; Turner, Stanley, et al., 1989) rather than a single latent factor. Results of the six factor model (i.e., five social

phobia factors and one agoraphobia factor) have been replicated in another investigation (i.e., Osman et al., 1995) whereas other studies have also found support for the two-factor model (Osman et al., 1995; Osman et al., 1996). What remains unclear is whether the previously found acceptable fit of the two-factor model is masking alternative underlying structures that would be more appropriate for certain subsamples. Particularly, it is unclear whether the hypothesized two-factor structure is appropriate for both non-clinical and clinical samples as well as for both male and female subgroups. The importance of examining this two-factor model is especially salient as scores derived from these factors are used regularly by both clinicians and researchers. To date, no study has examined the measurement invariance/equivalence of the SPAI between clinical and non-clinical samples of adults. Moreover, measurement invariance has not been established between females and males despite mixed results concerning sex differences in social phobia.

1.1 Aims of the Current Investigation

The current investigation attempts to test the theoretical model of the SPAI within these groups (i.e., control, social phobic, male, and female) to confirm whether the conceptual space of the SPAI as consisting of social phobia and agoraphobia is equivalent across control and social phobic groups, as well as across female and male groups. The first aim is to replicate previous findings supporting the two-factor structure of the SPAI between control and socially phobic samples. The second aim is to examine this two-factor structure in both females and males (including clinical and non-clinical participants). The third aim is to test the overall measurement equivalence of the two-factor structure of the SPAI between the control and socially phobic samples. Finally, the fourth aim is to test the overall measurement equivalence of the SPAI between females and males. These analyses will determine the invariance in the measurement of these symptoms in order to establish the appropriateness of the SPAI as a measure of social anxiety across different populations.

2. Method

2.1 Procedure

Participants included 420 adults both with and without a diagnosis of social phobia. The total sample of 420 adults consisted of two subsamples: (a) 379 participants recruited as part of a larger treatment study (see Beidel et al., 2010), and (b) 41 patients seeking services at the University of Central Florida Anxiety Disorders Clinic. Recruitment of the participants in the Beidel et al. (2010) study occurred through newspaper advertisements offering free treatment for socially anxious participants and financial compensation ($50.00) for control participants. The additional 41 participants included in this investigation were patients who received paid services from the University of Central Florida Anxiety Disorders Clinic. These were patients that were either referred to the clinic or were seeking treatment for social anxiety.

Telephone interviews were conducted with all participants to assess eligibility for the program. Following the telephone interview, participants from the Beidel et al. (2010) study were administered the Structured Clinical Interview for DSM-IV (SCID-I; First, Spitzer, Gibbon, & Williams, 1997) and participants from the Anxiety Disorders Clinic were administered the Anxiety Disorders Interview Schedule for DSM-IV (ADIS-IV; Di Nardo, Brown, & Barlow, 1994) by doctoral level psychologists or doctoral students in clinical psychology. Participants who did not meet criteria for any Axis I disorder were placed in the control group ($n = 200$). The social phobia group ($n = 220$) included participants who met DSM-IV-TR (APA, 2000) criteria for a diagnosis of social phobia. As described in Beidel et al. (2010), 20% of the diagnostic interviews conducted during the study were audio-recorded and rated by a blinded clinician to establish inter-rater reliability, which was adequate (κ = .

92). Diagnostic interviews for the Anxiety Disorders Clinic sample were not recorded; thus the inter-rater reliability was not available. However, data from each interview were carefully reviewed by a team of both doctoral level psychologists and doctoral students in clinical psychology. In the event that discrepancies in diagnosis arose, the third author (D. Beidel) provided the final decision in the diagnostic process.

2.2 Participants

Participant demographics are presented in Table 1. Participants in the control group ranged from 18 to 78 years of age (M = 39.77 years, SD = 15.41 years) and those in the social phobia group ranged from 18 to 81 years of age (M = 37.84 years, SD = 13.72 years). The two groups did not differ significantly in age, $F(1,418) = 1.84$, $p = .175$, $\eta_p^2 = .003$. There were slightly more males (52.5%) than females (47.5%) in the control group, whereas the opposite was true in the social phobia group (42.7% and 57.3%, respectively; $\chi^2(1, 420) = 4.01$, $p = .045$, $\Phi = -.098$). The control group was comprised mostly of Caucasians (57.0%) and African Americans (33.0%), but also included Asian (3.0%), other race (1.5%), Asian Indian (1.5%), and Latino (4.0%) participants. Caucasians (70.9%) made up the majority of the social phobia group, which also included African American (14.1%), Asian (5.5%), Asian Indian (1.8%), Latino (4.1%), and other race (3.6%) participants. There were several co-morbid diagnoses within the social phobia group. Specifically, 27.0% of the social phobia group met criteria for a secondary diagnosis. The most common co-morbid diagnoses in the social phobia group were generalized anxiety disorder (8.2%), depression (6.8%), dysthymia (3.2%), and specific phobia (3.2%). Table 1 presents a complete list of all co-morbid diagnoses for the social phobia group.

Demographics for the females and males are also presented in Table 1. Female participants ranged from 18 to 81 years of age (M = 39.67 years, SD = 13.63 years) and male participants ranged from 18 to 81 years of age (M = 37.75 years, SD = 15.50 years). The two groups did not differ significantly in age, $F(1,418) = 1.83$, $p = .177$, $\eta_p^2 = .004$. The female group was comprised mostly of Caucasians (66.1%), and included African American (22.6%), Asian (4.1%), Latino (4.1%), other race (2.7%), and Asian Indian (0.5%) participants. The male group was also comprised mostly of Caucasians (62.3%), and included African American (23.6%), Asian (4.5%), Latino (4.0%), other race (2.5%), and Asian Indian (3.0%) participants.

Slightly more participants in the female group (14.9%) met criteria for a co-morbid diagnosis when compared to the male group (13.0%), although the difference between groups was not significant, $\chi^2(1, 420) = .159$, $p = .690$, $\Phi = -.019$. The most common co-morbid diagnoses for the female group were generalized anxiety disorder (5.4%), depression (2.7%), specific phobia (2.7%), and obsessive compulsive disorder (1.8%). The most common co-morbid diagnoses for the male group were depression (4.5%), generalized anxiety disorder (3.0%), and dysthymia (2.5%). See Table 1 for a complete listing of all co-morbid diagnoses for the female and male groups.

2.3 Measures

All participants completed the SPAI at the Anxiety Disorders Clinic via pencil and paper format following the diagnostic interview. Following completion of the SPAI by each participant, study personnel verified that all items were completed in order to prevent the occurrence of missing data during final analyses. Items containing sub-items (i.e., Items 9 through 26 and 30 through 32) were calculated as an average of the sub-item values. With regard to the control and social phobia groups, the internal consistency was adequate for the overall SPAI (Cronbach's $\alpha = .96$ for both groups), the social phobia subscale (Cronbach's $\alpha = .96$ and .97 for the control and social phobia groups, respectively), and the agoraphobia

subscale (Cronbach's α = .82 and .86 for the control and social phobia groups, respectively). Mean SPAI scores for both the social phobia and control groups were consistent with previous investigations (i.e., mean control scores were less than, and mean social phobia scores were greater than previously suggested cutoffs [50–60, Turner et al., 1996; 88, Peters, 2000]). With regard to reliability for the SPAI within sex, the internal consistency was adequate for the overall SPAI (Cronbach's α = .98 for both females and males), the social phobia subscale (Cronbach's α = .99 for both females and males), and the agoraphobia subscale (Cronbach's α = .81 and .86 females and males, respectively).

3. Analyses and Results

3.1 Confirmatory Factor Analysis

3.1.1 Analyses—Initial analyses sought to confirm an a priori, two-factor oblique (correlated) solution for the SPAI social phobia and agoraphobia subscales. This item-level CFA was performed separately using data collected from participants in the control, social phobia, male, and female groups in order to confirm the hypothesized structure of the SPAI in each group as a precursor to measurement equivalence analyses. In each CFA, the loading of one item per factor was constrained to 1.0 in order to set the scale for each latent variable. To choose these referent items, a CFA was run for each of the four groups in which the variance of the latent variables was constrained to zero. Items with the most similar loadings across comparison groups (i.e., control/social phobic and female/male) for each latent variable were chosen as referent items for subsequent CFAs and measurement equivalence analyses. In addition, in each CFA, error terms for the following items were allowed to correlate due to similarity in wording and item content: 1 and 2, 2 and 10, 3 and 4, 3 and 5, 5 and 6, 5 and 22, 6 and 22, 7 and 8, 7 and 24, 8 and 25, 9 and 10, 13 and 14, 24 and 25, 26 and 30, and 31 and 32. Specifically, because the SPAI covers a wide range of social interactions, some items are structured similarly and/or refer to the same social situations with minor variations in presentation. For example, items 1 and 2 are structured similarly with a variation in the size of the group each item is referring to (i.e., "I feel anxious when entering social situations where there is a small group," and "I feel anxious when entering social situations where there is a large group"). Similarly, items 24 and 25 refer to a similar behavior (i.e., avoidance), but vary slightly in presentation (i.e., "I attempt to avoid social situations where there are…" and "I leave social situations where there are..."). Therefore, it appeared justified to include correlated uniquenesses for these 14 pairs of items, given their similarity (Cole, Ciesla, & Steiger, 2007). All models were estimated with LISREL 8.80 (Jöreskog & Sörbom, 1996) using maximum likelihood estimation (all variables were treated as continuous) and the results of the four CFAs may be found in Table 2.

3.1.2 Results—As shown in Table 2, results of the CFAs for the control (first column) and social phobia (second column) groups are relatively similar, with data from both groups confirming the two-factor solution. The overall fit of the SPAI was adequate for the control group (root mean square error of approximation [RMSEA] = .077; Tucker Lewis index [TLI] = .960; comparative fit index [CFI] = .960; standardized root mean square residual [SRMR] = .071) and acceptable for the social phobia group (RMSEA = .087; TLI = .961; CFI = .964; SRMR = .080). Standardized parameter estimates for the factor loadings were reasonable (average loadings = .63 and .65 for the control and social phobia groups, respectively; see columns 1 and 2 of Table 2.). The factor correlation between the social phobia and agoraphobia subscales was strong for the control group (r = .71) and moderate for the social phobia group (r = .47). The average correlations for the error terms of like-items was r = .24 and r = .25 for the control and social phobia groups, respectively.

Similarly, data from the female and male groups (columns 3 and 4 of Table 2 respectively) confirmed the hypothesized two-factor solution. The overall fit of the SPAI was acceptable

for both females (RMSEA = .094; TLI = .977; CFI = .979; SRMR = .064) and males (RMSEA = .081; TLI = .980; CFI = .981; SRMR = .060). Standardized parameter estimates for the factor loadings were reasonable (average loadings = .77 and .76 for females and males respectively; see Table 2). The factor correlation between the social phobia and agoraphobia subscales was strong for females (r = .68) and males (r = .68). The average correlations for the error terms of like-items was r = .13 for both females and males.

3.2 Measurement Equivalence

3.2.1 Analysis—Final analyses served to establish measurement equivalence across the control and social phobia groups as well as the female and male groups. Vandenberg and Lance (2000) presented a sequence of models for establishing measurement invariance that were used in the current investigation. In this sequence, the CFA solutions from the two pairs of groups were compared to assess the invariance of the SPAI social phobia and agoraphobia subscales across the groups. For further explanation of this sequential testing of models: configural invariance (Model 1) establishes the same pattern of factor loadings in the factor pattern matrix across groups; metric invariance (Model 2) adds constraints that require the factor loadings for like items to be of equal degree across groups; and scalar invariance (Model 3) holds the item-level intercepts of the regressions on the latent variables to be equal across groups. The comparison of fit across the nested Models 1 through 3 allows for empirical, step-by-step comparisons of model fit. For example, if model fit does not become significantly worse when adding constraints between Models 1 and 2, *weak measurement equivalence* is supported. Comparing the fit of Model 2 to that of Model 3 allows the researcher to examine the appropriateness of holding the item-level intercepts equal across the groups above and beyond that of setting their factor loadings to be equal, and if supported, allows for conclusions of *strong measurement equivalence*.

3.2.2 Results—Because of the χ^2 test's dependency on sample size (Jöreskog & Sörbom, 1996; Kline, 2005), which may result in significant changes in fit even when such changes are diminutive, alternate fit indices (i.e., RMSEA, TLI, CFI, & SRMR) were used to assess change in model fit after the addition of each constraint. Therefore, we present chi-square values in Tables 3 and 4, but we do not interpret these values as indicators of fit. In order to assess the comparative fit for each model, the progressive change in CFI (ΔCFI) was examined. Cheung and Rensvold (2002) suggest a ΔCFI larger than .01 to be indicative of non-equivalence; however, another, more conservative cutoff of a ΔCFI larger than .002 has also been recommended (Meade, Johnson, & Braddy, 2008) as an indicator of non-equivalence. Because multiple criteria for the cutoff value of ΔCFI have been proposed, we follow previous research in evaluating the overlap in 90% confidence intervals of RMSEA (Cadiz, Sawyer, & Griffith, 2009; Wang & Russell, 2005; see also Cheung & Rensvold, 2002) in addition to ΔCFI in order to assess comparative fit across nested models.

Regarding assessment of measurement equivalence across control and social phobia groups, we first tested configural invariance, which did not involve constraining any parameter estimates to be equal across groups. Results (see Table 3) showed acceptable fit of the configural invariance model (RMSEA = .085; SRMR = .080; TLI = .960; CFI = .961). These results suggest control and social phobic groups are accessing similar frames of reference when completing the SPAI (i.e., the items on the SPAI mean the same thing to both groups; Riordan & Vandenberg, 1994; Vandenberg & Lance, 2000). In contrast, if configural variance had not been supported, comparing scores across control and social phobic groups could be considered analogous to comparing "apples and spark plugs" (Vandenberg & Lance, 2000, p. 9).

To test weak measurement invariance, item loadings were set equal across the control and social phobic groups in the metric invariance model. Upon comparing the configural and metric invariance models, the metric invariance model did not result in a significantly worse fit (i.e., $\Delta CFI = -.0006$). This is less than even the most conservative cutoff criteria of $\Delta CFI \leq .002$ (Meade et al., 2008), and the RMSEA confidence intervals overlapped (configural invariance 90% CI: .082–.088, metric invariance 90% CI: .082–.088). These results support a finding of weak measurement equivalence across control and social phobic groups, which conceptually suggests the measures are calibrated similarly across groups (e.g., a response option of "3" means the same thing to both groups; Riordan & Vandenberg, 1994; Vandenberg & Lance, 2000).

In a subsequent test, item intercepts were constrained across groups as a test of scalar equivalence (i.e., a test of strong measurement equivalence). Our results support the equivalence of item intercepts across control and social phobic groups, and therefore also support a conclusion of strong measurement equivalence. The 90% confidence intervals for the metric and scalar invariance models overlapped (metric invariance 90% CI = .082 – .088; scalar invariance 90% CI = .082 – .088) and the ΔCFI of −.0011 met Meade et al.'s (2008) cutoff value of ΔCFI being smaller than .002 in order to support invariance. Because scalar invariance was supported, we conclude that comparisons of control and social phobia samples using the SPAI is appropriate, as the SPAI appears to be measuring the same construct, in the same way across both samples.

Results of the test of measurement invariance between females and males are presented in Table 4. Fit of the configural invariance model was adequate (RMSEA = .086; SRMR = .058; TLI = .978; CFI = .979), indicating females and males use similar frames of reference when completing the SPAI. As indicated by the small ΔCFI (.0003), the cutoff criterion for metric invariance was met (Cheung & Rensvold, 2002; Meade et al., 2008). Support for metric invariance was also indicated by overlapping RMSEA 90% confidence intervals between configural (RMSEA 90% CI: .083 – .089) and metric (RMSEA 90% CI: .084 –.090) invariance models. Support for metric invariance suggested similar item calibration across male and female groups, and provided evidence for weak measurement equivalence. Finally, scalar invariance was tested by constraining the item intercepts to be equal across groups. The test of scalar invariance was supported across male and female groups. The ΔCFI (−.0018) met Meade et al.'s (2008) cutoff criteria for invariance and the RMSEA 90% CI's for the metric and scalar models overlapped (metric invariance: RMSEA 90% CI = .084 – .090; scalar invariance: RMSEA 90% CI = .084 – .090). These results echo previous investigations of measurement invariance in the short form of the SPAI which found similar evidence of invariance across sex (Roberson-Nay, Strong, Nay, Beidel, & Turner, 2007; Schry, Roberson-Nay, & White, in press). Thus, we conclude the SPAI exhibited evidence of strong measurement equivalence across sexes, supporting comparisons of SPAI scores across males and females because the SPAI appears to assess social anxiety in the same way across both samples.

4. Discussion

The aim of this investigation was to further establish the psychometric properties of the SPAI. The two-factor structure was replicated in various samples (i.e., control, social phobia, female, and male), confirming the appropriateness of the two-factor social phobia and agoraphobia dimensions, as previously supported (e.g., Osman et al., 1995; Osman et al., 1996; Turner, Beidel, et al., 1989). Accomplishing these first two aims was an important step as the two-factor structure of SPAI has not been simultaneously supported within these four populations prior to this study.

Another goal of this investigation was to examine the measurement invariance of this two factor structure in patients with and without a diagnosis of social phobia. Strong measurement invariance between the control and social phobia samples was established by even the most conservative criteria, suggesting that the SPAI is assessing the same construct in the same way in individuals with and without a diagnosis of social phobia, a finding that has not been examined in previous investigations. The final aim of the study was to examine the overall measurement invariance of the two-factor structure between females and males, once again including patients both with and without a diagnosis of social phobia. Strong measurement invariance was established across males and females, supporting mean-level comparisons of social phobia in these groups (whereas previously, any male/female differences in social phobia could have been attributed to actual differences in social phobia or simply nonequivalence in the measure used to assess social phobia).

4.1 Theoretical and Practical Implications

The results of this investigation provide important evidence of the measurement equivalence of the SPAI. Establishing equivalence between the control and social phobia samples provides confidence for clinicians and researchers who use the SPAI to assess and compare social phobia across populations. In particular, by applying the sequence of models proposed by Vandenberg and Lance (2000) to these data, we were able to demonstrate the following: (a) items on the SPAI hold the same meaning for individuals diagnosed with social phobia and those with no psychiatric diagnosis, (b) numerical ratings of severity and frequency for the individual SPAI items hold the same meaning for individuals with and without a diagnosis of social phobia, and (c) the SPAI appears to be measuring the same constructs, specifically social anxiety and agoraphobia, similarly across those with and without a diagnosis of social phobia. These results support the postulation that the SPAI may be used to measure social anxiety in both clinical and non-clinical populations with the confidence that the construct is being assessed equivalently in either group.

In addition to the implications for the assessment of social anxiety in both clinical and non-clinical populations, these data contribute to previous literature examining the theoretical construct of social anxiety. Previous data suggest that multiple facets of social anxiety, including feared situations and impairment that results from fear of those social situations, present in both clinical and non-clinical populations (e.g., Dell'Osso et al., 2003; Fehm et al., 2008; Heiser et al., 2003; Heiser et al., 2009; Merikangas et al., 2002; Stein et al., 1996; Stein et al., 2000; Stemberger et al., 1995; Turner et al., 1990). These data bolster prior notions that the SPAI may be used to measure social anxiety invariantly in those with and without a diagnosis.

The results of this investigation likewise demonstrate that the SPAI equivalently measures social anxiety in both females and males despite diagnostic status (i.e., individuals with and without a diagnosis of social phobia were included in each sex group). Once again, the results demonstrated that items on the SPAI, numerical ratings of severity and frequency for the individual SPAI items, and the constructs of social anxiety and agoraphobia hold the same meaning for both females and males. Given the mixed results of previous investigations examining sex differences in social anxiety (Edelmann, 1985; Turk et al., 1998; Wittchen, Stein, & Kessler, 1999; Xu et al., 2012; Yonkers et al., 2001), the current results suggest that the SPAI taps into the same conceptualization of social anxiety in both males and females, and thus, can be used to differentiate true sex differences in social phobia without fear of inappropriate conclusions being drawn from nonequivalent measurement.

4.2 Limitations

One potential limitation of these results is that the equivalence found in the current investigation applied only to social anxiety as measured with the SPAI. Other measures of social phobia may exhibit nonequivalence across clinical and non-clinical samples and/or males and females, as the results of the current investigation do not necessarily generalize to other social phobia measures. A second limitation concerns the generalizability of conclusions drawn from a single sample of control and social phobic individuals. Although the properties of the samples used in the current paper appear to reflect larger populations of individuals with and without clinical diagnoses of social phobia, replications of the current findings in additional samples would bolster support for strong measurement equivalence. Third, while the SCID-I is a gold-standard diagnostic measure, it includes only limited questions about social phobia, making diagnosis difficult. While the diagnoses were reliable (as indicated by the kappa provided), the use of the SCID-I to diagnose social phobia is still a potential limitation of this study. Finally, while most diagnoses for the sample were derived from the use of the SCID-I, a small amount were derived using the ADIS-IV. Although both of these diagnostic interviews are considered gold-standard clinical tools, our use of different diagnostic measures for inclusion is a potential limitation of this investigation.

5. Conclusion

Overall, the current investigation provided evidence supporting the two-factor (social phobia and agoraphobia subscales) structure of the SPAI in control and social phobic samples, as well as in females and males. As such, the SPAI may be used to compare levels of social anxiety across these samples with increased confidence. Future research would benefit from investigating measurement equivalence of the SPAI across time and additional subpopulations (e.g., across cultures, age groups, etc.).

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Research Highlights

- The SPAI equivalently measures social anxiety in social phobic and control groups
- The SPAI equivalently measures social anxiety in females and males
- Social anxiety is perceived similarly between these groups
- It is suitable to use the SPAI to compare these groups on social anxiety severity

Table 1

Demographics

Demographic	Control (*n* = 200) M (*SD*)	Social Phobia (*n* = 220) M (*SD*)	Female (*n* = 221) M (*SD*)	Male (*n* = 199) M (*SD*)
Age	39.77 (15.41)	37.84 (13.72)	39.67 (13.63)	37.75 (15.50)
SPAI Social Phobia Subscale	32.84 (22.32)	113.37 (35.31)	79.70 (50.54)	69.83 (49.22)
SPAI Agoraphobia Subscale	9.33 (7.36)	18.98 (11.90)	16 (12.08)	12.58 (9.59)
SPAI Difference Score	23.52 (18.44)	94.39 (31.65)	63.70 (43.94)	57.25 (44.05)
	n (%)	*n* (%)	*n* (%)	*n* (%)
Sex				
Male	105 (52.5%)	94 (42.7%)	--	--
Female	95 (47.5%)	126 (57.3%)	--	--
Race				
African American	66 (33.0%)	31 (14.1%)	50 (22.6%)	47 (23.6%)
Asian	6 (3.0%)	12 (5.5%)	9 (4.1%)	9 (4.5%)
Caucasian	114 (57.0%)	156 (70.9%)	146 (66.1%)	124 (62.3%)
Asian Indian	3 (1.5%)	4 (1.8%)	1 (0.5%)	6 (3.0%)
Latino/a	8 (4.0%)	9 (4.1%)	9 (4.1%)	8 (4.0%)
Other	3 (1.5%)	8 (3.6%)	6 (2.7%)	5 (2.5%)
Comorbid Diagnoses				
Generalized Anxiety Disorder	--	18 (8.2%)	12 (5.4%)	6 (3.0%)
Depression	--	15 (6.8%)	6 (2.7%)	9 (4.5%)
Dysthymia	--	7 (3.2%)	2 (0.9%)	5 (2.5%)
Specific Phobia	--	7 (3.2%)	6 (2.7%)	1 (0.5%)
Obsessive Compulsive Disorder	--	4 (1.8%)	4 (1.8%)	0
Alcohol Dependence	--	3 (1.4%)	1 (0.5%)	2 (1.0%)
Panic Disorder without Agoraphobia	--	3 (1.4%)	2 (0.9%)	1 (0.5%)
Cannabis Dependence	--	1 (0.5%)	0	1 (0.5%)
Posttraumatic Stress Disorder	--	1 (0.5%)	0	1 (0.5%)

Note. SPAI = Social Phobia and Anxiety Inventory (Turner, Beidel, & Dancu, 1996).

Table 2

Confirmatory Factor Analyses of Social Phobia and Agoraphobia Scales

	Factor Loadings			
Observed Variables and Factors	**Control (*n* = 200)**	**Social Phobia (*n* = 220)**	**Female (*n*=221)**	**Male (*n*=199)**
SPAI				
Item 1 (SP)	.655	.811	.887	.881
Item 2 (SP)	.737	.759	.881	.898
Item 3 (SP)	.815	.679	.846	.878
Item 4 (SP)	.834	.695	.872	.868
Item 5 (SP)	.820	.137	.675	.771
Item 6 (SP)	.635	.404	.780	.771
Item 7 (SP)	.477	.761	.877	.885
Item 8 (SP)	.340	.672	.823	.828
Item 9 (SP)	.769	.904	.951	.954
Item 10 (SP)	.726	.799	.901	.926
Item 11 (SP)	.738	.831	.898	.907
Item 12 (SP)	.765	.899	.939	.950
Item 13 (SP)	.818	.727	.835	.892
Item 14 (SP)	.834	.790	.884	.885
Item 15 (SP)	.770	.708	.777	.792
Item 16 (SP)	.823	.852	.916	.901
Item 17 (SP)	.701	.751	.853	.791
Item 18 (SP)	.992	.900	.927	.933
Item 19 (SP)	.942	.896	.945	.943
Item 20 (SP)	.438	.468	.597	.648
Item 21 (SP)	.305	.361	.541	.468
Item 22 (SP)	.722	.353	.755	.808
Item 23 (SP)	.753	.630	.778	.806
Item 24 (SP)	.617	.810	.896	.896
Item 25 (SP)	.470	.674	.827	.769
Item 26 (SP)	.721	.737	.873	.862
Item 27 (SP)	.771	.862	.921	.914
Item 28 (SP)	.503	.592	.808	.765
Item 29 (SP)	.802	.705	.799	.854
Item 30 (SP)	.653	.798	.901	.913
Item 31 (SP)	.304	.553	.779	.737
Item 32 (SP)	.333	.525	.773	.718
Item 33 (AG)	.257	.553	.518	.576
Item 34 (AG)	.536	.650	.726	.674
Item 35 (AG)	.529	.708	.741	.708
Item 36 (AG)	.480	.677	.684	.677
Item 37 (AG)	.610	.707	.783	.785

Observed Variables and Factors	Factor Loadings			
	Control (*n* = 200)	Social Phobia (*n* = 220)	Female (*n*=221)	Male (*n*=199)
Item 38 (AG)	.355	.493	.537	.537
Item 39 (AG)	.779	.562	.612	.590
Item 40 (AG)	.820	.529	.570	.377
Item 41 (AG)	.708	.549	.598	.616
Item 42 (AG)	.363	.426	.483	.393
Item 43 (AG)	.389	.347	.455	.271
Item 44 (AG)	.470	.593	.545	.516
Item 45 (AG)	.394	.575	.611	.688
Fit indices				
χ^2 *(df)*	2038.570 * (929)	2482.575 * (929)	2719.305 * (929)	2137.387 * (929)
RMSEA (90% CI)	.077 (.073–.082)	.087 (.083–.092)	.094 (.090–.098)	.081 (.077–.086)
TLI/CFI/SRMR	.960/.960/.071	.961/.964/.080	.977/.979/.064	.980/.981/.060

Note. SPAI = Social Phobia and Anxiety Inventory (Turner, Beidel, & Dancu, 1996); SP = social phobia factor (subscale); AG = agoraphobia factor (subscale); RMSEA = root mean square of approximation; SRMR = standardized root mean square residual; TLI = Tucker Lewis index; CFI = comparative fit index; *df* = degrees of freedom; CI = confidence interval. Completely standardized solutions. Factor correlation = .71 (Control), . 47 (Social Phobic), .68 (Female) and .68 (Male). Average factor loading = .63 (Control), .65 (Social Phobic), .77 (Female) and .76 (Male).

* represents a significant χ^2 value with probability of .05. The error terms for the following items were allowed to correlate based on the listed contextual similarity: addressing providing a speech: 5 & 6, 5 & 22, 6 & 22; sentence structure/wording: 1 & 2, 2 & 10, 3 & 4, 3 & 5, 9 & 10, 13 & 14; avoidance: 7 & 8, 7 & 24, 8 & 25, 24 & 25; cognitive response to anxiety: 26 & 30; physiological response to anxiety: 31 & 32.

Table 3

Measurement Equivalence Across Informants (Control Versus Social Phobia)

Measurement Equivalence Model	χ^2	$\Delta\chi^2$	*df*	RMSEA (90% CI)	SRMR	TLI (NNFI)	CFI	ΔCFI
SPAI								
1. Configural invariance	4643.685	--	1860	.085 (.082–.088)	.080	.960	.9606	--
2. Metric invariance	4751.421	107.736*	1901	.085 (.082–.088)	.110	.960	.9600	–.0006
3. Scalar invariance	4875.589	124.168*	1948	.085 (.082–.088)	.110	.955	.9589	–.0011

Note. SPAI = Social Phobia and Anxiety Inventory (Turner, Beidel, & Dancu, 1996); *df*= degrees of freedom; RMSEA = root mean square of approximation; CI = confidence interval; TLI = Tucker Lewis index; NNFI = nonnormed fit index; CFI = comparative fit index; SRMR = standardized root mean square residual; ΔCFI = change in CFI; $\Delta\chi^2$ = change in χ^2; ΔCFI < .002 represents reasonable comparative fit;

*represents a significant change in χ^2 with probability of .05.

Table 4

Measurement Equivalence Across Sexes

Measurement Equivalence Model	χ^2	$\Delta\chi^2$	*df*	RMSEA (90% CI)	SRMR	TLI (NNFI)	CFI	ΔCFI
SPAI								
1. Configural invariance	4851.356	--	1860	.086 (.083–.089)	.058	.978	.9793	--
2. Metric invariance	4922.687	71.331*	1901	.087 (.084–.090)	.075	.979	.9796	.0003
3. Scalar invariance	5051.364	128.677*	1948	.087 (.084–.090)	.075	.977	.9778	–.0018

Note. SPAI = Social Phobia and Anxiety Inventory (Turner, Beidel, & Dancu, 1996); *df*= degrees of freedom; RMSEA = root mean square of approximation; CI = confidence interval; TLI = Tucker Lewis index; NNFI = nonnormed fit index; CFI = comparative fit index; SRMR = standardized root mean square residual; ΔCFI = change in CFI; $\Delta\chi^2$= change in χ^2; ΔCFI < .002 represents reasonable comparative fit;

*represents a significant change in χ^2 with probability of .05.