The Latent Structure Of Social Anxiety Disorder And The Performance Only Specifier: A Taxometric Analysis

By: **Grace B. Boyers, Joshua J. Broman-Fulks,** David P. Valentiner, Kathleen McCraw, **Lisa Curtin,** and **Kurt D. Michael**

Abstract

Social anxiety disorder (SAD) is often treated as a discrete diagnostic entity that represents a naturally occurring class, though empirical evidence largely supports a dimensional conceptualization of social fears. Further, the inclusion of a "performance only" specifier in the DSM-5 implies that individuals who experience intense social anxiety exclusively in performance situations are distinct from those with broader social fears. The purpose of the present research was to examine the latent structure of SAD and the DSM-5 "performance only" specifier in a large nonclinical sample (n = 2019). Three taxometric procedures (MAXCOV, MAMBAC, and L-Mode) were applied to indicators derived from two commonly used measures of social anxiety. Results yielded convergent evidence indicating that social anxiety exhibits a dimensional latent structure. Further, social performance anxiety demonstrates continuous relationships with milder social fears, suggesting that the "performance only" specifier may not represent a discrete entity. The implications of these findings for the assessment, diagnosis, classification, and treatment of social anxiety are discussed.

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The latent structure of social anxiety disorder and the performance only specifier: a taxometric analysis

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ABSTRACT

Social anxiety disorder (SAD) is often treated as a discrete diagnostic entity that represents a naturally occurring class, though empirical evidence largely supports a dimensional conceptualization of social fears. Further, the inclusion of a "performance only" specifier in the DSM-5 implies that individuals who experience intense social anxiety exclusively in performance situations are distinct from those with broader social fears. The purpose of the present research was to examine the latent structure of SAD and the DSM-5 "performance only" specifier in a large nonclinical sample ($n = 2019$). Three taxometric procedures (MAXCOV, MAMBAC, and L-Mode) were applied to indicators derived from two commonly used measures of social anxiety. Results yielded convergent evidence indicating that social anxiety exhibits a dimensional latent structure. Further, social performance anxiety demonstrates continuous relationships with milder social fears, suggesting that the "performance only" specifier may not represent a discrete entity. The implications of these findings for the assessment, diagnosis, classification, and treatment of social anxiety are discussed.

KEYWORDS

Social anxiety; performance; anxiety; dimensional; taxometric

Introduction

Social anxiety disorder (SAD), or pervasive fears of social or performance situations, tends to be a pervasive, chronic, and debilitating condition that affects occupational, social, and academic functioning (Bruch, Fallon, & Heimberg, 2003). Although current nosology conceptualizes SAD as a discrete pathological phenomenon, research has indicated that social fear is a common experience, with nearly one-quarter of adults experiencing at least one significant social fear during their lifetime (Ruscio et al., 2008). The universality of social fear and the prevalence of SAD have led some to question whether SAD represents a naturally occurring class or continuously distributed phenomenon (e.g. Rapee & Spence, 2004).

Several lines of evidence suggest that social anxiety may have a dimensional latent structure. For example, impairment due to social fears appears to increase linearly with number of social fears, with no detectable threshold (Stein, Torgrud, & Walker, 2000), and

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individuals tend to oscillate over time between subthreshold and full diagnostic levels of symptomology (Merikangas, Avenevoli, Acharyya, Zhang, & Angst, 2002). Further, scores on measures of anxiety and avoidance in social situations (Mattick & Clarke, 1998; Stein et al., 2000; Watson & Friend, 1969) tend to be distributed normally. Conversely, some infant temperament research provides evidence that social anxiety may have a categorical latent structure. Behavioral inhibition, a consistent display of restrained or fearful behaviors in response to unfamiliar social stimuli, is a risk factor for the development of social anxiety in adolescence (e.g. Schwartz, Snidman, & Kagan, 1999), and taxometric research suggests that high infant reactivity, a temperamental antecedent to behavioral inhibition and social anxiety (Kagan, 2001), has a categorical, or taxonic, latent structure (Woodward, Lenzenweger, Kagan, Snidman, & Arcus, 2000). Evidence of taxonicity in a potential developmental precursor to SAD raises the possibility that social anxiety itself may also be taxonic.

To date, four taxometric studies have been conducted to assess the latent structure of SAD, and results have been somewhat inconsistent. In the first study, Kollman, Brown, Liverant, and Hofmann (2006) administered the Social Interaction Anxiety Scale (SIAS), Albany Panic and Phobia Questionnaire, and the Anxiety Disorders Interview Schedule to a sample of 2035 outpatients diagnosed with anxiety and mood disorders. Results of three taxometric procedures yielded convergent evidence indicating that social anxiety is a dimensional construct. Similarly, two additional studies using data from the National Comorbidity Survey Replication (NCS-R; Ruscio et al., 2008) and two Australian epidemiological samples (Crome, Baillie, Slade, & Ruscio, 2010) provided further support for social anxiety being dimensional. In contrast, a study by Weeks, Carleton, Asmundson, McCabe, and Antony (2010) reported finding support for a social anxiety taxon in a mixed sample of SAD patients and community members who had completed the Social Phobia Scale (SPS) and SIAS. However, prior research has indicated that using separate putative taxon and complement member samples (i.e. separate clinical and community population samples) can produce pseudotaxonic results (Schmidt, Kotov, & Joiner, 2004) due to measurement artifacts, raising questions regarding the validity of the taxonic findings, and supporting the need for additional taxometric research to clarify the latent structure of social anxiety.

Performance only specifier

A review of the literature reveals considerable disagreement regarding whether SAD should be divided into one or more subtypes based on the number or type of feared situations. This debate is clearly reflected in the ever evolving diagnostic criteria and terminology applied to individuals with social fears. For example, the term "social phobia" was initially introduced in the DSM-III (American Psychiatric Association, 1980) to identify individuals who feared a single specific situation, such as public speaking. Based on the observation that many individuals exhibited fears of multiple social interaction situations, the definition was broadened in the DSM-IIIR (American Psychiatric Association, 1987) and a "generalized" subtype was added and later retained and expanded upon in the DSM-IV (American Psychiatric Association, 2000). However, the most recent revision to the DSM (DSM-5; American Psychiatric Association, 2013) saw to the removal of the generalized subtype and addition of a "performance only" specifier.

The debate regarding whether SAD reflects one or more qualitatively distinct groups or a continuum of severity centers on several observations. Specifically, individuals with multiple social interaction fears tend to differ from those with specific performance fears

in several potentially meaningful ways. For example, individuals with broad social fears are more likely to be women, younger, have an earlier age at onset, and have lower income and education than those with performance only fears. In addition, individuals with multiple social fears report greater avoidance, fear of negative evaluation, and overall anxiety in social situations, and they tend to exhibit more social deficits and higher comorbidity rates, especially with anxiety and mood disorders, than individuals who only fear performance situations (Herbert, Hope, & Bellack, 1992; Holt, Heimberg, & Hope, 1992; Turner, Beidel, & Townsley, 1992). Evidence also suggests that differences in heritability/familial transmission rates and treatment responsivity may distinguish between those with multiple versus performance only fears (Hook & Valentiner, 2002; Mannuzza et al., 1995).

Other research appears to contraindicate the delineation of SAD subtypes based on the type of social situations feared. For example, some research suggests that distinguishing between individuals with broad versus performance only fears does not impart additional predictive value above and beyond a continuous conceptualization of SAD based on number of social fears (Vriends, Becker, Meyer, Michael, & Margraf, 2007). A recent study using the NCS-R found that individuals who feared at least 8 of 14 possible social situations were at greater risk for experiencing comorbid major depression, anxiety disorders, and suicidal ideation (El-Gabalawy, Cox, Clara, & Mackenzie, 2010), though differences between those with generalized social fears versus performance only fears were no longer significant once number of feared situations was controlled for. In addition, factor analysis of the 14 performance and interactional fears indicated that both proposed dimensions loaded onto a single latent factor.

Given the mixed evidence, some researchers have argued that social anxiety associated with performance only fears may exhibit a unique latent structure compared to generalized social anxiety. Specifically, Hook and Valentiner (2002) suggested performance anxiety to be categorical in structure, reflecting its similarity with other simple phobias, whereas broad social anxiety was hypothesized to have a dimensional latent structure based on evidence of its additive heritability. However, others have challenged this conceptualization (Carter & Wu, 2010), suggesting that both conjectured constructs are likely dimensional, but distinguishable based on their antecedents (i.e. performance vs. interaction situations) and distinct patterns of correlates and evaluative processes (Hook, Valentiner, & Connelly, 2013). Although the utility of distinguishing between performance only and broad social anxiety has become conventional, and several instruments have been developed to measure symptoms in these areas (Mattick & Clarke, 1998), researchers have yet to apply taxometric analyses, or a set of statistical procedures designed to discern the latent structure of a construct, to the proposed performance only specifier.

Knowing the latent structure of SAD and the performance only specifier has important implications for construct conceptualization, assessment, and treatment (Meehl, 1995). For example, classification provides the field with an operationalization of a phenomenon and represents the foundation for theory (Cronbach & Meehl, 1955). In addition, latent structure research informs etiological research, with taxonic structure suggesting the existence of a discrete etiological source (e.g. biological disposition, environmental event, or a specific interaction of multiple sources), and dimensional structure implying an additive or graded etiology. In addition, the goal of assessment instruments is influenced by latent structure, with tests for taxonic variables often aiming to assign individuals to their respective group with maximum efficiency and accuracy, and measures of dimensional variables generally aiming to locate an individual's relative position on a continuum (see Grove, 1991, for an extended discussion on this point).

The purpose of the present research was twofold: (1) to provide additional clarification regarding the latent structure of SAD, and (2) expand upon previous social anxiety taxometric work by examining the latent structure of the proposed "performance only" subtype. Based on previous taxometric and related research, it was hypothesized that taxometric analyses of SAD and the "performance only" subtype would yield evidence of continuous rather than categorical latent structures.

Method

Participants

Participants consisted of 2019 (57% female) college students at a large Midwestern university who volunteered to participate in one of six research studies between 2003 and 2009 in exchange for course credit. Participants ranged in age from 17 to 53 (M = 19.23, SD = 2.65) and were predominately Caucasian (69%) and African American (16%). Participants were individually administered the SIAS and SPS as part of a larger battery of screening or baseline assessment measures prior to any experimental tasks or manipulations (e.g. Fergus, Valentiner, McGrath, Gier-Lonsway, & Kim, 2012; Renner, Valentiner, & Holzman, 2017). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

Measures

The SIAS and SPS (Mattick & Clarke, 1998) are two related, but distinct measures of social anxiety that were developed together. Each questionnaire consists of 20 items assessed using the same five-point Likert scale, ranging from 0 ("not at all characteristic or true of me") to 4 ("extremely characteristic or true of me"). The SIAS is designed to measure social interaction anxiety (e.g. anxiety when interacting with authority figures, acquaintances, members of the opposite sex, etc.), whereas the SPS assesses distress in performance-specific anxiety (e.g. public speaking, eating or writing in front of others). The psychometric properties of the SIAS and SPS have been extensively investigated, with results indicating high test-retest reliability and internal consistency (Mattick & Clarke, 1998), and both measures exhibited high levels of internal consistency in the present sample (SPS α = .93; SIAS α = .87). Research has also indicated that the SPS and SIAS are able to discriminate between individuals with SAD versus healthy controls and individuals with other anxiety disorders (e.g. Brown et al., 1997; Heimberg, Mueller, Holt, Hope, & Liebowitz, 1992; Mattick & Clarke, 1998).

Procedure

Taxometric procedures

The latent structure of SAD and the performance only specifier were examined using three taxometric procedures: maximum covariance (MAXCOV; Meehl & Yonce, 1996), mean above minus below a cut (MAMBAC; Meehl & Yonce, 1994), and latent mode (L-mode; Waller & Meehl, 1998). The procedures were performed using R statistical software (2005)

and taxometric algorithms published by Ruscio (2012). Taxometric plots were visually inspected and rated as taxonic, dimensional, or ambiguous by two experienced taxometric researchers, who were in perfect (100%) agreement in their independent plot ratings. Simulated taxonic and dimensional plots were generated using Monte Carlo data that matched the unique distributional characteristics (i.e. skew, sample size, nuisance covariance, etc.) of the research data to aid in the interpretation of study results (Ruscio & Ruscio, 2004). In addition, an objective measure of fit, the comparison curve fit index (CCFI; Ruscio, Ruscio, & Meron, 2007), was implemented to supplement visual assessments. CCFI scores range from .0 to 1.0, with values <.45 supporting dimensional structure and >.55 supporting taxonic structure (Ruscio & Walters, 2011). To derive parameter estimates and generate categorical comparison data, cases were assigned to the putative taxon and complement groups using the mean base rate classification method (Ruscio, 2009).

Results

Preliminary analyses

SPS total scores in the present sample ranged from 0 to 80 (M = 15.85, SD = 12.93), and straightforward SIAS scores ranged from 0 to 68 (M = 17.17, SD = 12.01), which is consistent with or somewhat higher than scores reported in previous research using non-clinical samples (e.g. Heimberg et al., 1992; M_{SPS} = 12.5, SD_{SPS} = 11.5; Rodebaugh et al., 2011; M_{SIAS} = 16.3, SD_{SIAS} = 12.5). Although research on the straightforward SIAS and SPS has not yielded a clear cutoff score to delineate between normal and disordered social anxiety, earlier studies have used a "caseness" strategy, defining the threshold as one standard deviation above Heimberg et al. (1992) community sample mean on either measure (SIAS ≥ 34 or SPS ≥ 24; Brown et al., 1997; Heimberg et al., 1992). Applying the previously used means and standard deviations to the caseness strategy yielded a base rate of 30% in the current sample, with a large number of individuals meeting criteria on one (N = 624; *SIAS* n = 480, *SPS* n = 460) or both measures (N = 316). Similarly, using a more stringent threshold of one and a half standard deviations above the mean yielded a base rate of 19.7%, with 409 participants meeting criteria on one measure (*SIAS* n = 268; *SPS* n = 312) and 171 meeting criteria on both measures (8.1%).

The structural relationships underlying the 17 straightforward SIAS items and 20 SPS items were evaluated to ensure the six samples of undergraduates used to create the larger sample were suitable to combine to create the larger sample for taxometric analysis. More specifically, multiple-group analysis in LISREL 8.54 (Jöreskog & Sörbom, 2003) was used to evaluate whether the inter-item relationships could be restricted to be invariant across samples. Robust maximum likelihood estimation (Satorra & Bentler, 1994), which analyzes covariance and asymptotic covariance matrices, was used because, unlike maximum likelihood estimation, this method does not rely upon assumptions of normality (Brown, 2006). We determined adequate model fit using three criteria (see Brown, 2006; Hu & Bentler, 1999): (1) a comparative fit index (CFI) of greater than .95; (2) a non-normed fit index (NNFI) of greater than .95; and (3) a root mean square error of approximation (RMSEA) less than .06. Constraining the relationships between the 17 SIAS items to be identical across the six samples resulted in a good model fit [χ^2 (df = 765) = 2418.43, p < .01; CFI = .98; NNFI = .98; RMSEA = .043]. Similarly, constraining the relationships between

the 20 SPS items to be identical across the six samples resulted in a good model fit [χ^2 (df = 1050) = 4098.16, $p < .01$; CFI = .97; NNFI = .97; RMSEA = .052]. These analyses provided no evidence of differential structural relationships between the items as a function of sample.

Social anxiety disorder

Indicator selection process

Given disagreement in the literature regarding the factor structure of the SIAS and SPS (e.g. Carleton et al., 2009; Heidenreich, Schermelleh-Engel, Schramm, Hofmann, & Stangier, 2011; Safren, Turk, & Heimberg, 1998), indicators of the putative SAD taxon were generated via exploratory factor analysis (EFA) of straightforward SIAS (i.e. not including reverse scored items; see Rodebaugh et al., 2011) and SPS items using Principal Axis Factoring with a Promax oblique rotation. Only the straightforward SIAS items were used as recommended by Rodebaugh, Woods, and Heimberg (2007) based on research indicating that the reverse-scored items consistently demonstrate weaker relationships with several comparison measures than straightforward items, and the removal of reverse-scored items improves the scale's psychometric properties. Previous taxometric research has supported the use of factor analytically derived indicators, which minimize artifactual nuisance correlations, provide comprehensive representation of the various facets of a construct, and optimize the internal consistency of indicators (see Schmidt et al., 2004). Items with initial communalities less than .40 were removed, and factors were extracted based on an Eigenvalue greater than 1.0 and the inflection point on a scree plot (Cattell, 1966). All items with factor loadings less than .40 were discarded, and the remaining items that loaded on each factor were averaged to create indicators.

A three-factor model was extracted based on the scree test and Eigenvalues greater than 1.0; these three factors accounted for 58.77% of the total variance. The first factor consisted of nine items from the SIAS that assessed predominately interaction-related anxiety concerns (e.g. talking to other people or expressing oneself; items 10, 12, 14, 15, 16, 17, 18, 19, and 20). The second factor consisted of seven items from the SPS that assessed performance anxiety while engaged in passive or involuntary behaviors (e.g. standing in line or on an elevator; SPS items 8, 9, 14, 15, 16, 17, and 19), and the third factor consisted of five SPS items assessing performance anxiety during active behaviors (e.g. during public speaking or carrying a tray across a room; SPS items 4, 6, 13, 18, and 20). Each indicator was constructed by averaging the items with acceptable loadings on each factor.

Taxometric results

The three social anxiety indicators exceeded minimum validity criteria (>1.25 SD) and demonstrated nuisance correlations (i.e. within conjectured group correlations) within tolerable limits (see Table 1). In addition, inspection of the simulated MAXCOV, MAMBAC, and L-Mode plots revealed that the social anxiety data were capable of producing interpretable output. Thus, the indicators and taxometric procedures were deemed appropriate for analysis.

A visual inspection of the three MAXCOV plots revealed that none of the curves yielded peaks characteristic of taxonic structure and were consistent with a dimensional solution. In addition, the research curves closely resembled the dimensional simulated plot (see Figure 1)

Table 1. Psychometric properties of the social anxiety indicators, and summary of taxometric output for MAXCOV, MAMBAC, and L-Mode analyses of the social anxiety data.

	Validity (SD)	Indicator correlations (full sample)	Within group correlations (taxon, complement)	Mean indicator skew	Mean indicator kurtosis	CCFI scores
Social anxiety	2.56 (.17)	.68	.16, .41	1.07	.89	.39
"Performance Only" subtype	2.79 (.19)	.66	.13, .33	1.34	1.51	.37

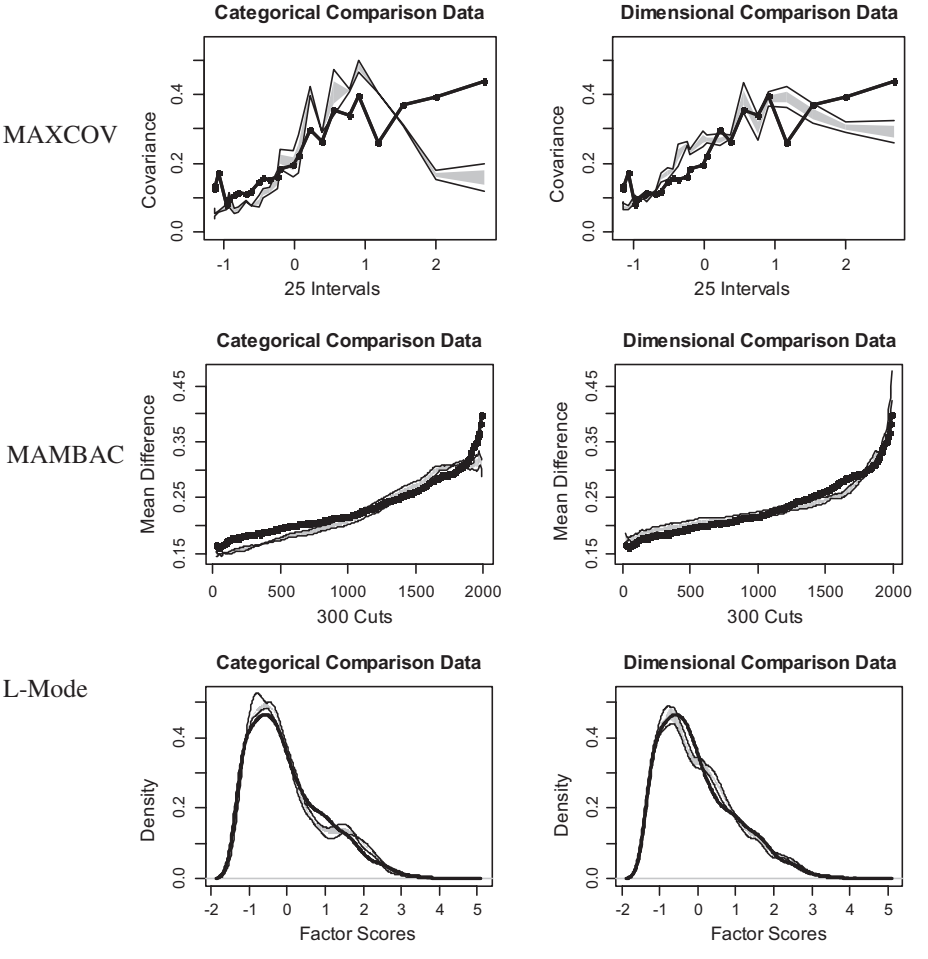

Figure 1. Averaged social anxiety disorder MAXCOV (top), MAMBAC (middle), and L-Mode (bottom) curves imposed on simulated categorical (left) and dimensional (right) comparison curves.

and were rated as dimensional by independent raters. A visual inspection of the six MAMBAC plots revealed that all six rose slightly to the right, with a distinctive incline at the far right of the plot. A comparison of the data plots with simulated taxonic and dimensional plots revealed that the data plots were consistent with the simulated dimensional plots, and all six plots were rated as dimensional by independent raters. Similarly, a visual inspection of

the L-Mode density distribution revealed a unimodal curve, which is suggestive of dimensionality and in contrast to the bimodal structure of the categorical comparison curves. The research curve more closely resembled the dimensional comparison curve and was rated as dimensional by both raters. The mean CCFI score, which provides an objective index of whether the data plots more closely resemble simulated taxonic or dimensional plots, was .39, thereby supporting the visual interpretation and providing additional objective evidence that social anxiety is dimensional.[1] The mean base rate estimate across the procedures was 20.8%, suggesting that enough putative taxon group members were present in the sample to detect a taxon had one been present.

Performance only specifier

Indicator construction

Composite indicators of the "performance only" subtype were created by combining pairs of SPS items that demonstrated strong correlations and appeared to be measuring similar facets of SSA ($r > .50$), without significant inter-indicator correlations or content overlap. The use of composite indicators helps to ensure that indicators contain a sufficient number of response points to generate reliable results (e.g. Broman-Fulks et al., 2006), and is consistent with methodology used in previous social anxiety taxometric research (e.g. Weeks et al., 2010). Analyses indicated that three pairs of SPS items met criteria and were selected as performance anxiety indicators (Indicator 1 = items 12 and 15; Indicator 2 = items 16 and 17; Indicator 3 = items 19 and 20).

Performance only taxometric results

Preliminary analyses revealed that the three composite SPS indicators met minimum validity criteria (Table 1), and visual inspection of the simulations supported the ability of the SPS indicators to distinguish between a taxon and dimension (Figure 2). MAXCOV analyses of the SPS item pairs generated three curves, none of which demonstrated a clear peak. Rather, the three curves were highly consistent with simulated dimensional curves. Similarly, MAMBAC generated six curves, all of which lacked peaks and were consistent with dimensional simulations. The L-Mode curve exhibited a single peak, lacking the second peak exhibited by simulated taxonic plots. All 10 performance only plots were rated as dimensional by independent raters, and the averaged CCFI score supported the dimensional interpretation (CCFI = .37).[2]

Discussion

The present study examined the latent structure of SAD by applying taxometric procedures to data assessing social anxiety in a large undergraduate sample. Multiple taxometric procedures generated convergent evidence that social anxiety is a dimensional construct. Taxometric plots were consistently rated as dimensional by two independent raters, and an objective fit index supported visual interpretations. These findings are consistent with previous research supporting a continuous structure of social anxiety (Crome et al., 2010; Kollman et al., 2006; Ruscio, 2010), but contrast with the taxonic findings reported in a fourth study (Weeks et al., 2010). Taken together, it appears that differences in levels of

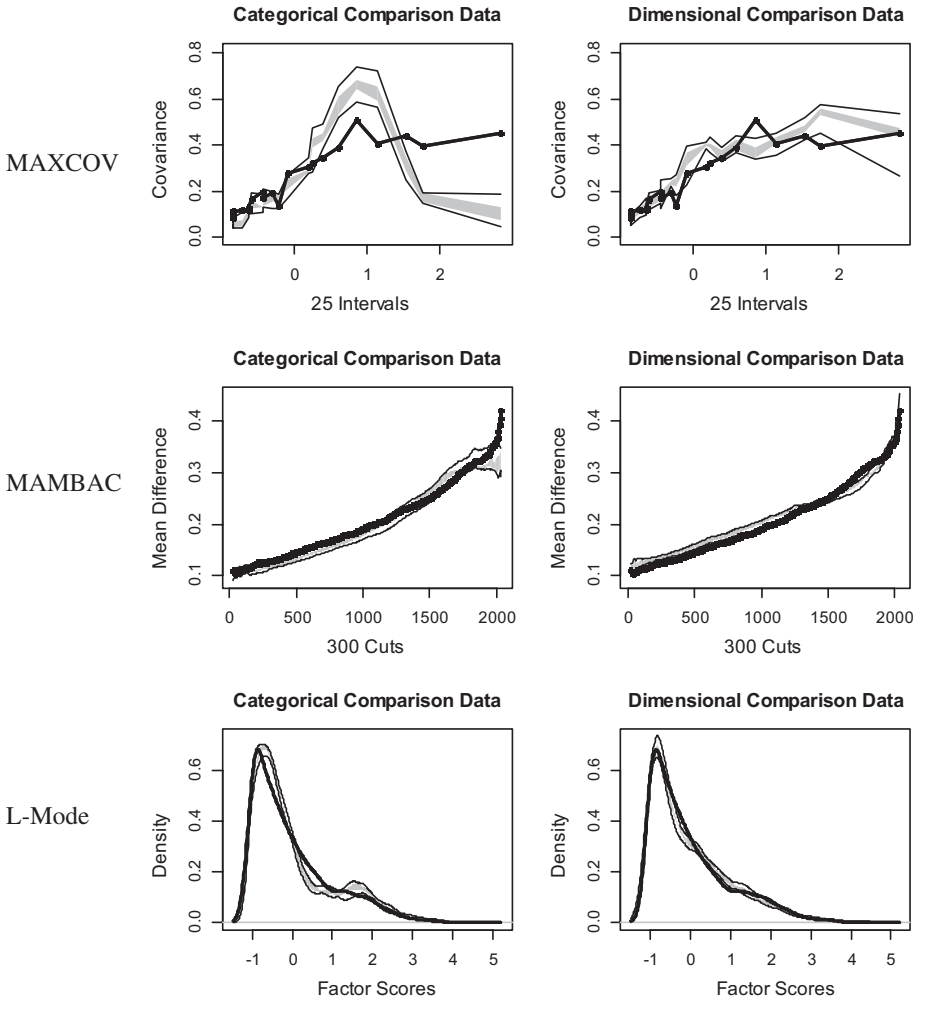

Figure 2. Averaged "performance only" social anxiety (SPS) MAXCOV (top), MAMBAC (middle), and L-Mode (bottom) curves imposed on simulated categorical (left) and dimensional (right) comparison curves.

social anxiety reflect quantitative rather than qualitative differences between "disordered" and "non-disordered" individuals.

The present research represents the first direct investigation of the latent structure of the proposed "performance only" subtype. Some researchers have argued that qualitative differences found between individuals with broad versus performance-specific social anxiety provide evidence for separate latent structures, with performance anxiety possessing taxonic latent structure and generalized social anxiety being dimensional (Hook & Valentiner, 2002). However, results of the present study failed to support this hypothesis. Rather, results of multiple taxometric procedures generated convergent evidence that performance anxiety is also dimensional at the latent level. These findings indirectly support recent non-taxometric research asserting a continuous structure of social anxiety without subtypes (El-Gabalawy et al., 2010; Ruscio et al., 2008; Vriends et al., 2007), and suggest that performance anxiety

represents a variation along a single social anxiety dimension. The lack of a categorical distinction between individuals with generalized and performance only social anxiety raises particular concerns regarding the clinical utility of the "performance only" specifier listed in the recently released DSM-5. Specifiers are reportedly intended to "define a more homogeneous subgrouping of individuals with the disorder" (American Psychiatric Association, 2013, pp. 21, 22). However, given the preponderance of evidence suggesting that the latent structure of social anxiety is dimensional, individuals with "performance only" fears do not necessarily represent a homogeneous subgroup of individuals with social anxiety. Rather, it appears that a more graded, dimensional approach to classifying social anxiety severity would provide a more nuanced methodology that more accurately reflects the quantitative, rather than qualitative, differences between individuals with varying levels of social fears. However, given that the present research represents the first taxometric study of SAD subtypes to date, additional research is warranted to replicate these findings and test other potential subgroupings along the social anxiety spectrum.

These findings have several important implications for assessment, diagnosis, and treatment of social anxiety. For example, results indicate that social fears will be optimally assessed using instruments designed to measure the full range of social anxiety and discriminate across the distribution of scores. In contrast, measures that aim to sort individuals into SAD or non-SAD groups are contraindicated given that dichotomization of a continuous variable results in a loss of potentially important data (Cohen, 1983). Similarly, a continuous distribution of social anxiety symptoms also influences the nosological conceptualization of SAD. Although DSM conceptualizations are reportedly intended to serve as useful heuristics, and drawing diagnostic lines between disordered and normal levels of social anxiety may serve some practical clinical and research utility (e.g. providing a common language that can be applied with reasonable interrater reliability), it is important to note that DSM diagnoses are often not treated as heuristics, and many, including SAD, do not appear to represent naturally occurring classes that exist independent of a rater (e.g. Kendell & Jablensky, 2003). In such circumstances, a more accurate alternative nosology would be to represent these disorders as quantitative deviations from health, as is done with some medical conditions (e.g. hypertension), and to set diagnostic thresholds based on empirical outcome data (see Hyman, 2010; for an extensive discussion on this point). Further, treatment approaches that aim to minimize problematic social anxiety symptoms and maximize dimensional measures of therapeutic change would be more appropriate than treatment programs and research designs that simply aim to move individuals from a qualitative "disordered" to "non-disordered" status, as the demarcation between having and not having the conjectured disorder is arbitrary, and the absence of meeting diagnostic criteria does not necessarily equate to an absence of "symptoms" or impairment. In addition, it should be noted that these results support modern etiological theories that posit additive or graded models for social anxiety. For example, some modern behavioral models posit that general biological (e.g. genetics, behavioral inhibition) and psychological (e.g. early uncontrollable or unpredictable life experiences) vulnerability factors combine with stress and direct negative experiences in socio-evaluative situations to affect the development of social anxiety (Bitran & Barlow, 2004). However, any of these variables alone would be insufficient to generate high social anxiety without interaction with other factors. The results of the current study appear consistent with such etiological theories in that different

levels of social anxiety across individuals may be the result of combinations of vulnerability factors of varying strengths or impact.

The current research has several strengths, including the use of two commonly used measures of social anxiety, multiple taxometric procedures and consistency tests, and large sample size (n = 2019). However, there are several limitations that should be taken into account when interpreting these findings. For example, the use of indicators derived from two relatively similar self-report measures of social anxiety may be considered a potential limitation, though it should be noted that the indicators demonstrated strong psychometric properties and complemented the results of prior taxometric research using diverse indicators. A second potential limitation of the present research was the use of a large non-clinical undergraduate sample, which may have limited the numbers of individuals in the sample with severe levels of social anxiety symptomology. Although structured diagnostic interviews were not administered to participants, precluding a precise calculation of the base rate of SAD diagnoses in the sample, previous research estimates the base rate of SAD in the general population from 12 to 13% (Kessler et al., 1994; Ruscio et al., 2008), and analyses using a "caseness" approach (Brown et al., 1997; Heimberg et al., 1992) suggested that the base rate of SAD in the present sample was likely close to 20% using more conservative cutoffs than those used in prior research (1.5 SD above the sample mean). Thus, it is highly unlikely that the non-detection of an SAD taxon is attributable to the use of an undergraduate sample or applying taxometric procedures to a sample containing too few putative taxon members. Finally, although extensive empirical data provide strong support for the utility of taxometric procedures in determining whether a construct is categorical or dimensional, taxometric procedures are limited in their ability to detect the presence of multiple (i.e. more than 2) categories in a data-set. Future research using statistical approaches that permit the subdivision of populations into more than two prospective groups (e.g. factor mixture modeling) may help to extend research regarding the latent structure of social anxiety.

Notes

1. Taxometric analyses were also conducted using composite indicators representing the 3 factors originally identified by Safren et al. (1998). The results generally supported a dimensional solution, with each of the 4 MAXCOV and L-Mode plots exhibiting a characteristic dimensional shape and the mean CCFI score being .37 (i.e. less than .45), though the MAMBAC procedure did not pass the initial suitability test as the raters could not discriminate between simulated taxonic and dimensional plots. In addition, MAXEIG analyses, a multivariate extension of MAXCOV that can handle larger numbers of indicators, were conducted using all of the SPS and SIAS items excluded by our EFA as indicators. After discarding several items that failed to meet minimum validity criteria (>1.25; Meehl, 1995), results of the MAXEIG analyses provided strong support for a dimensional solution (CCFI = .11), suggesting that the findings of the primary analyses were not an artifact of the indicators derived by the EFA. However, to conserve space and ease interpretability of findings, only results generated using the indicators derived via EFA in the present study are presented in the text.
2. MAXEIG analyses were also conducted using each of the individual SPS items as indicators of "performance only" social anxiety. After excluding nearly half of the items due to failure to meet minimum validity criteria, results supported the dimensional results reported using the empirical approach to indicator selection (SPS CCFI = .40).

Disclosure statement

All authors declare they have no conflicts of interest. No animal studies were carried out by the authors for this article.

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