Further examination of the factor structure of the Chapman Psychosis Proneness Scales (CPPS)

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A B S T R A C T

Results of recent analyses of the Chapman Psychosis Proneness Scales (CPPS) have been inconsistent with regard to their factor structure. This inconsistency has involved whether the Revised Social Anhedonia Scale (SocAnh) reflects only the negative or both the negative and positive dimensions of schizotypy, along with the degree of correlation between these two dimensions. In the present study, confirmatory factor analysis was used to compare models created by Chan et al. and Kwapil et al.; a third model was constructed based on adjustments to these prior models and consideration of the schizotypy construct. Following Kwapil et al., our model allowed for bi-loading of SocAnh scale, but eliminated the correlation between positive and negative factors. Although fitness for each of the previously offered models was adequate, RMSEA and chi-square indicators suggested ideal fit for the model proposed by Kwapil and our new model, which redirects variance thought to be shared among the positive and negative dimensions to its specific source, SocAnh. The implications of these competing models with regard to our conceptualization of schizotypy are addressed. It is suggested that the cross loading of SocAnh reflects the notion of social anhedonia as the core of schizotypic personality organization.

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1. Introduction

Schizotypy is a multidimensional construct that helps organize the numerous and varied traits associated with liability to schizophrenia spectrum disorders. The characteristics associated with schizotypy vary along a continuum that ranges from normal functioning to a full expression that includes significant impairment resulting from the associated characteristics of cognitive slippage, and personality disturbance in the form of anhedonia, interpersonal aversiveness, and ambivalence. Being in possession of any one or a combination of these traits is an indicator that an individual has an increased risk for schizophrenia. The current conceptualization of schizotypy draws much from the observations of Meehl (1962), who observed the traits of individuals thought to fall within his schizoid taxon. Recent research suggests that the traits associated with schizotypy are distributed normally in the population (Grant et al., 2015). Exact density parameters notwithstanding, the construct is dimensional in nature and can be used to study liability to schizophrenia spectrum disorders, which may help in developing methods to delay or prevent onset of schizophrenia, as well as further understanding of its developmental course.

1.1. Psychometric identification of schizotypy and schizophrenia proneness

The CPPS includes four scales that measure the traits associated with liability to psychosis. The Perceptual Aberration Scale (PerAb; Chapman et al., 1978) is a measure of unusual sensory experiences and body image distortions. The Magical Ideation Scale (MagId; Eckblad and Chapman, 1983) is a measure of odd or unfounded beliefs. The Revised Physical Anhedonia Scale (PhysAnh; Chapman et al., 1976) captures an inability to experience pleasure from sensory or aesthetic experiences. The Revised Social Anhedonia Scale (SocAnh; Eckblad et al., 1982) taps into social withdrawal related to a lack of interest or pleasure derived from relationships.

Psychometric identification of schizotypy is generally made with indicators of schizotypy such as the CPPS or Schizotypal Personality Questionnaire (SPQ; Raine, 1991). Whereas measures such as SPQ were created to measure psychopathology, the CPPS was designed as an indicator of future psychosis, and was validated by the creators through the use of longitudinal research with this purpose in mind. Initial research tied scores on four scales to mental health outcomes ten years later (Chapman et al., 1994). Incidence of psychotic disorders, paranoid and schizotypal
PD symptoms, mood disorders, and psychosis in relatives was higher among individuals who scored highly on Magld or PerAb or both, particularly given their report of psychotic-like experiences at initial contact, when compared to controls. Reporting on results from the same study, Kwapil (1998) found that individuals who scored highly on SocAnh displayed greater rates of schizophrenia spectrum personality disorders regardless of initial mental health status, and that this score in combination with those on PerAb and Magld and initial psychotic-like experiences helped to predict psychosis at follow-up.

Subsequent research replicated and further validated the predictive validity of the CPPS, with Gooding et al. (2005) finding that high scores on the Revised Social Anhedonia, as well as Per-Mag, were predictive of any schizophrenia spectrum disorder five years later, and that both subsets of deviant participants had at least one DSM personality disorder (Gooding et al., 2007). Cross-sectional research has provided further corroboration of the utility of SocAnh specifically, even in the absence of elevations on PerAb or Magld (and also, uniquely, beyond the college-student scope in a community-based sample; Blanchard et al., 2011).

1.2. Structure of the schizotypy construct

The literature on the latent structure of the schizotypy construct is mixed. Some researchers advocate a two-factor structure including positive and negative dimensions, whereas others argue for a three-factor model including a disorganized dimension (Boyda et al., 2013), and still others argue for a fourth paranoid disorder (Wuthrich and Bates, 2006). The number of factors revealed in various investigations of schizotypy is, to a large extent, dependent upon the measure incorporated by a given study. For example, a three-factor structure has been demonstrated for the SPQ in both psychiatric and nonpsychiatric samples (Chen et al., 1997). Investigations of the factor structure of the CPPS have mainly produced models with two dimensions, positive and negative, despite some studies producing well-fitting three factor models (Wuthrich and Bates, 2006).

Meehl (1962) conceptualized social discomfort as the core component of schizophrenic phenomenology. Following his descriptions of this social dimension as involving fear of others and expectation of rejection, Chapman et al. (1976) constructed the initial Social Anhedonia scale to assess for social anxiety and lack of social interest. The focus of this scale was narrowed following results suggesting that elevations were not only caused by schizotypic social fear, but also markedly more commonplace social anxiety (Mishlove and Chapman, 1985). Even used alone, this scale is a useful predictor of later diagnosis of a schizophrenia spectrum disorder; using this scale in combination with Magld can facilitate more accurate prediction of psychosis (Kwapil, 1998).

Recent work on CPPS factor structures has called into question the role of social anhedonia, as measured by SocAnh, in the schizotypy construct. Kwapil et al. (2008), for example, found that the best-fitting model featured bi-loading of SocAnh onto both positive and negative dimensions with these broader dimensions demonstrating a weak negative correlation of −0.10. This research collaborative conducted follow-up analyses of CPPS data (Gross et al., 2014) and found a similarly weak negative correlation between positive and negative factors at −0.08. More recently, Chan et al. (2015) conducted a large-scale investigation of the factor structure of the CPPS among nonpsychiatric undergraduates in China and proposed that the best-fitting model for the CPPS features SocAnh loading only on the negative dimension of schizotypy, but with a moderate, positive correlation of 0.33 between the broader positive and negative dimensions. To further complicate our understanding of the factor structure of the CPPS, Cihan et al. (2015) have recently reported that a best-fitting model among 266 Turkish medical students featured SocAnh cross loading on both the positive and negative dimensions (i.e., similar to the models of Gross et al. and Kwapil et al.), but with the positive and negative dimensions demonstrating a positive correlation of 0.18 (i.e., similar to the Chan et al. model). The relatively small N in this study, however, calls the resultant model’s stability into question. It should also be noted that Cihan et al. did not provide overall means for each of the CPPS scales in their report.

The primary difference between the models of Chan et al. (2015) and the others noted above is the treatment of SocAnh, as only the Chan et al. study suggested that the best-fitting model had this scale load only on the negative factor. It is further noted that both the strength and direction of the correlation between the positive and negative dimensions varies. One reason for this variation could be that the relationship between the dimensions in Chan et al.’s model is simply a reflection of SocAnh’s relationship with the positive dimension. Thus, if a model does not restrict the association between SocAnh and positive schizotypy, it may be that the correlation between the underlying dimensions falls away – or is at least substantially reduced, as in the Cihan et al. (2015) model. In the present study, we sought to examine the effect of allowing SocAnh to load simultaneously onto positive and negative factors on the association between these underlying factors.

1.3. Present study

The purpose of the present study was to provide another investigation of the factor structure of the CPPS in a sample of college students who have never met diagnostic criteria for schizophrenia or related psychotic disorder. We expected to find support for a two-factor structure similar to those chosen by Chan et al. (2015) and Kwapil et al. (2008), with some modifications; however, we seek further clarification of whether SocAnh loads only on the negative dimension or cross-loads on the positive dimension, and this cross-loading may account for the positive correlation between the positive and negative dimensions of schizotypy as observed by Chan et al.

2. Method

2.1. Participants

Participants were 1125 (313 men, 812 women) college students between the ages of 18 and 25 years who produced valid CPPS forms; validity was defined as having fewer than 10 omitted items and scoring less than 3 on the CPPS Infrequency scale. Approximately 83.1% of male participants identified as White/Caucasian, as did 79.6% of female participants. Approximately 11.2% of male participants identified as African American, while 14.4% of female participants did so. As the current study is part of a larger longitudinal study of psychosis proneness, individuals who participated in the study completed a number of additional measures related to psychosis proneness including a self-report questionnaire regarding personal and family mental health history, measures of neurocognitive functioning, emotion recognition and handedness. For inclusion in the larger study’s final sample, participants’ responses had to meet validity criteria for additional measures beyond those included in the current study. In addition to the CPPS, validity measures of the MMPI-2 were utilized.

2.2. Procedure

Procedures of the larger study were reviewed and approved by the university institutional review board. Participants, who were recruited by the researchers from introductory psychology courses
3. Results

3.1. Descriptive statistics

Descriptive statistics for each scale are shown in Table 1. Cronbach’s α estimates for each scale were above 0.80, which is usually considered indicative of good internal consistency. Likewise, average item correlation estimates for each scale were generally in the acceptable range, although the value for PhysAnh is somewhat lower than one would ideally prefer, which suggests that the scale may be multidimensional despite its acceptable α estimate (c.f., Clark and Watson, 1995; Cortina, 1993).

3.2. Estimating model fit

Confirmatory factor analysis with ML estimation was used to examine the fitness of several possible models to the data. Following Chan et al. (2015), we incorporated an item parceling technique (Little et al., 2002) in which the items of each scale were divided into three “parcels” based on item-total correlations. Items were assigned to each of the parcels in forward and backward sequence, in order to ensure that each parcel included a balanced proportion of items from each third of the scale. In addition, correlations among the errors associated with three parcels of MagId and PhysAnh scales were estimated, also following Chan et al.

First, we tested the model identified as best-fitting by Chan et al. (2015). This was a two-factor model in which we estimated loadings for MagId and PerAb onto a positive factor and SocAnh and PhysAnh onto a negative factor. In this model, positive and negative factors were allowed to correlate with each other. The second model tested was identical to the first except that SocAnh was allowed to load onto both the positive and negative factors; this was the model chosen as best-fitting by Kwapil et al. (2008). Finally, we tested a model in which a non-significant correlation between the positive and negative dimensions of schizotypy was trimmed.

The goodness of fit for each model was examined via the following indices: the goodness of fit index (GFI; Jöreskog and Sörbom, 1984), the adjusted goodness of fit index (AGFI), the comparative fit index (CFI; Bentler, 1990), root mean squared error of approximation (RMSEA; Browne and Cudeck, 1993) Akaike’s information criterion (Akaike, 1973), and chi-square goodness-of-fit. Figs. 1–3 present the factor loadings and correlations associated with each of these models; Table 2 presents the corresponding fit indices.

An examination of Table 2 reveals that both the Chan et al. (2015) and Kwapil et al. (2008) models achieved acceptable levels of fit on the GFI, AGFI, and CFI. However, the model based on Chan et al. resulted in a significant chi-square and an RMSEA outside of the bounds of “close” fit (Brown, 2006). The Kwapil et al. model provided significant improvement, $\chi^2(3) = 129.7, p < 0.001$, and an RMSEA value that met criteria for close fit (e.g., below 0.05).

Based on the results of this second model, an additional model was estimated, trimming the non-significant correlation between the positive and negative schizotypy factors. This model did not significantly diminish fit to the data, $\chi^2(1) = 2.0, ns$, relative to that of Kwapil et al.

4. Discussion

In selecting the best-fitting model, we considered how our findings build upon recent work on the factor structure of the CPPS, as well as current theory on the latent structure of schizotypy. The current study yielded a best-fitting model that allowed SocAnh to cross-load on both the positive and negative dimensions of schizotypy. This supports previous efforts (c.f., Cihan et al., 2015; Gross et al., 2014; Kwapil et al., 2008) that suggested the best-fitting models for the structure of the CPPS allowed this cross loading of SocAnh.

Although our best-fitting model is inconsistent with that suggested by Chan et al. (2015), who argued for unidimensional loading of SocAnh, it is noted that their model actually fit our data reasonably well; had we only been seeking confirmation of their model, we would have said that we had found it. However, the competitive examination of these two models provides greater support for the Kwapil et al. (2008) model, and makes it obvious that the correlation between the positive and negative dimensions of schizotypy, as measured by the CPPS, is an artificial result of the lack of double loading for SocAnh in the Chan et al. model.

Chan et al. (2015) noted that a possible reason for the differences in their model compared to earlier examinations might be their use of a culturally different sample. The significance of this is suggested by the fact that the sample had relatively higher scores on PhysAnh, PerAb, and MagId than did the American samples in earlier reports, whereas SocAnh scores among the Chinese participants were lower compared to those found in previous samples. The pattern of scores obtained in the present study mirrors this pattern in that scores on PhysAnh, PerAb, and MagId were higher relative to the means obtained among the Chinese sample used by Chan et al. It is noted, however, that Cihan et al. (2015) have reported a model featuring bi-loading of SocAnh in a Turkish sample although they did not report overall means for each of the CPPS scales.

Our results display remarkable consistency with those of Gross et al. (2014) and Kwapil et al. (2008), who demonstrated that the correlation between the positive and negative dimensions of CPPS-measured schizotypy is negligible when SocAnh is allowed to load onto both dimensions. We extended this observation to demonstrate that the correlation between the two dimensions is unnecessary; the fit of the model without this correlation was not

Table 1

Descriptive statistics for the CPPS scales.

<table>
<thead>
<tr>
<th>Scale</th>
<th>M</th>
<th>SD</th>
<th>α</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing CPPS items</td>
<td>0.36</td>
<td>0.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>0.53</td>
<td>0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SocAnh</td>
<td>9.49</td>
<td>5.96</td>
<td>0.84</td>
<td>0.13</td>
</tr>
<tr>
<td>PhysAnh</td>
<td>15.07</td>
<td>6.74</td>
<td>0.80</td>
<td>0.06</td>
</tr>
<tr>
<td>MagId</td>
<td>7.14</td>
<td>4.96</td>
<td>0.82</td>
<td>0.14</td>
</tr>
<tr>
<td>PerAb</td>
<td>4.03</td>
<td>4.08</td>
<td>0.83</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Note: N=1125. α=Cronbach’s α. AIC=average item correlation.
Based on the results of our study and previous studies, it appears that the correlation between the positive and negative dimensions of the CPPS suggested by the model of Chan et al. (2015) is a result of the double-loading of SocAnh. It is noted that Chan et al. found adequate fit for two models that allowed the SocAnh to load on both positive and negative factors. However, SocAnh loadings on positive schizotypy were relatively small for these models; Chan et al. also pointed out the theoretical purpose of the SocAnh as encompassing negative schizotypy as a motivation for their selection of the best model.

Some, however, have differed with regard to whether SocAnh is exclusively a measure of negative schizotypy. Kwapił (1998) found poorer functioning, which could be thought to be associated with the negative dimension of schizotypy, was more prominent in participants scoring highly on SocAnh compared to controls. Interestingly, however, participants scoring highly on PerAb were more likely than controls to report depressive symptoms, but participants in the SocAnh were not. Kwapił also noted that individuals who scored highly on SocAnh had more severe psychotic-like experiences compared to study controls; he likened these experiences to milder forms of the positive symptoms of schizophrenia.

Further, Lewandowski et al. (2006) have indicated that symptoms of depression and anxiety are more strongly associated with the positive dimension of schizotypy than with the negative symptom dimension and that SocAnh demonstrates modest positive correlations with measures of anxiety and depression. They argued that this supports the notion that SocAnh measures both the positive and negative dimensions of schizotypy. Given their inclusion of measures of anxiety and depression, they suggested a three-factor model that included the dimension of negative affect.

We would suggest that the fact that SocAnh correlates highly with both the positive and negative dimensions of schizotypy as measured by the CPPS – whether through correlated factors or cross-loading – supports notions of social anhedonia as comprising the core of schizotypy (Meehl, 1962). Our results highlight that positive and negative schizotypy may be relatively independent, but an observation of schizotypy will generally include the presence of social anhedonia. We feel that this distinction is an important one, versus simply stating that the two dimensions are correlated; we argue that the important question is why they are correlated.

Although a two-factor structure most closely fits most CPPS data, studies utilizing other measures suggest that a three- or four-
factor model best reflects latent schizotypy. Previous research has demonstrated an association between scores on PerAb and the presence of disordered thought and communication and social skills deficits (Edell and Chapman, 1979; Haberman et al., 1979; Martin and Chapman, 1982; Miller and Chapman, 1983), which suggests that some elements of schizotypy (i.e., disorganization) are not adequately measured within the two-factor structure. In this data, the extent to which the CPPS tapped disorganization, causing elevations on both SocAnh and the purely positive-symptom scales, suggesting double-loading of SocAnh, remains unclear.

An individual with emerging disorganization with fragmented scattering of thoughts may endorse both “I have never doubted that my dreams are the products of my own mind” (from MagId) because they have trouble keeping their thoughts straight, in the deviant direction, and “There are few things more tiring than to have a long, personal discussion with someone” (from SocAnh) due to finding the expression of thoughts and intuiting of others’ mental states required when engaging in conversation to be taxing.

An additional consideration with regard to the present results concerns what appears to the lack of unidimensionality within the PhysAnh scale, as noted by its relatively low AIC. Cortina (1993) has offered a thorough explanation of how a scale of sufficient length may demonstrate an adequate Cronbach’s alpha estimate in the presence of multidimensionality, which appears to be the case in the present study. How this apparent multidimensionality of PhysAnh impacts the factor loading of SocAnh should be the focus of further research.

One weakness of our study is our reliance on a sample of college undergraduates, although it has been pointed out (c.f., Chan et al., 2015) that much of the extant literature on schizotypy is based on research with college students. Although traditionally aged college students represent the age range in which one would expect to witness the development of schizotypy-related thoughts and behaviors, those that enroll in college may experience less prodromal disturbances than those who do not. Additionally, the discrepant findings between Chan et al. (2015) and Kwapil et al. (2008) suggest the need for further cross-cultural studies utilizing the CPPS, in order to clarify the extent to which cultural factors may have influenced the results.

As noted above, the lack of a disorganization dimension is reflective of the choice of scales with which we measured schizotypy. Indeed, scales such as the SPQ (Raine, 1991) and O-Life (Mason et al., 1995; Mason and Claridge, 2006) assess for three
and four dimensions, respectively, and it is not clear how the scales of the CPPS would map onto the dimensions assessed by these latter instruments. We are currently engaged in collecting data to answer that question, which we hope will lead to enhanced understanding of the dimensional structure of schizotypy.

References


