Cognitive-Perceptual, Interpersonal, and Disorganized Features of Schizotypal Personality

by Adrian Ralne, Chandra Reynolds, Todd Lencz, Angela Scerbo, Nelly Triphon, and Deborah Kim

Abstract

While two factors are currently thought to underlie individual differences in schizotypal personality, three factors may best explain schizotypal traits. This study used confirmatory factor analysis to assess five competing models of schizotypal personality in the general population: null model, one-factor model, simple two-factor model, Kendler two-factor model, and three-factor model. The computer program LISREL was used to analyze Schizotypal Personality Questionnaire subscale scores that reflect the nine traits of schizotypal personality. The scores were obtained from (1) a sample of 822 undergraduates and (2) a replication sample of 102 subjects drawn from the community. Results indicate replicable support for a three-factor model reflecting cognitive-perceptual, interpersonal, and disorganized latent factors. Low intercorrelations between the first two factors and the lack of fit by a one-factor model are partially inconsistent with recent notions that a single vulnerability dimension underlies schizotypal personality. It is argued that future investigations should assess the correlates of all three schizotypal factors in clinical and nonclinical samples in addition to the two more traditional factors. It is hypothesized that three factors of schizophrenic symptomatology observed in recent studies may reflect an exaggeration of three analogous factors found in the general population.

Schizotypal personality disorder, as defined by DSM–III–R (American Psychiatric Association 1987), is made up of a series of nine signs and symptoms reflecting cognitive, perceptual, social, interpersonal, and behavioral dysfunction. The disorder is thought to be genetically related to schizophrenia (Kendler et al. 1981; Gunderson et al. 1983; Kety 1983). Self-report measures of psychosis proneness and schizotypal personality have been developed to measure either individual features of schizotypal personality in the general population (Chapman et al. 1976, 1978) or three of the nine features (Claridge and Broks 1984; Venables et al. 1990), but no previous scale assesses all nine schizotypal features. The Schizotypal Personality Questionnaire (SPQ; Raine 1991) was developed to meet this need. The SPQ is based on DSM–III–R criteria for schizotypal personality disorder and, in addition to a total scale, it contains a separate subscale for each of the nine schizotypal features. The SPQ has been validated against DSM–III–R diagnoses of schizotypal personality disorder, and 55 percent of subjects scoring in the top 10 percent of SPQ scores have been diagnosed as having such a disorder (Raine 1991).

One important question is how many distinct components underlie schizotypal personality in the general population. Several competing models can be hypothesized. A one-factor model could be hypothesized on the grounds that a single vulnerability dimension underlies schizotypal personality. The SPQ has been validated against DSM–III–R diagnoses of schizotypal personality disorder, and 55 percent of subjects scoring in the top 10 percent of SPQ scores have been diagnosed as having such a disorder (Raine 1991).

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ality) underlies all nine features. The prevalent view, however, is that a simple two-factor model can best explain schizotypal personality. Siever and Gunderson (1983) and Widiger et al. (1986) have conceptualized some schizotypal features (ideas of reference, magical thinking, unusual perceptual experiences, odd speech, paranoid ideation) as reflecting aspects of cognitive-perceptual dysfunction, whereas other features (social anxiety, no close friends, constricted affect) are thought to reflect deficits in interpersonal functioning. Similarly, DSM-III-R groups schizotypal features into two factors representing “peculiarities of ideation, appearance, and behavior,” on the one hand, and “deficits in interpersonal relatedness,” on the other (American Psychiatric Association 1987, p. 340). Several factor analyses of schizotypal and psychosis-prone personality scales have generally uncovered two factors related to “positive” and “negative” schizotypal features (Allen et al. 1987; Muntaner et al. 1988; Bentall et al. 1989; Raine and Allbutt 1989). Not all of the nine DSM-III-R schizotypal traits are represented in these analyses, however, and one recent analysis by Kendler and Hewitt (1992) resulted in three factors.

The only empirical analysis conducted to date (to the authors’ knowledge) that incorporates all schizotypal features suggests a modification of the simple two-factor model. Kendler et al. (1991) assessed schizotypal features in 29 pairs of normal twins with the Structured Interview for Schizotypy (Kendler et al. 1989). An exploratory factor analysis revealed two factors, which were labeled as positive and negative schizotypal features. While the model was similar to the simple two-factor model, two important differences were that (1) paranoid ideation and social anxiety loaded on both factors, whereas they have been traditionally viewed as belonging to cognitive-perceptual and interpersonal factors, respectively, and (2) odd behavior loaded on the negative rather than the positive factor (see table 1).

A fourth model suggests that three factors underlie individual differences in schizotypal personality. This model stems from recent data suggesting that a two-dimensional (positive and negative) model fails to adequately explain symptomatology in schizophrenia patients, and that instead three factors (positive, negative, and disorganized) provide a better fit (Bilder et al. 1985; Liddle and Barnes 1990; Arndt et al. 1991). Bilder et al. (1985) were one of the first groups to identify this three-factor structure. Following this work, Arndt et al. (1991) used factor analysis on data from 207 schizophrenia patients assessed with the Scale for the Assessment of Negative Symptoms (Andreasen 1982) and the Scale for the Assessment of Positive Symptoms (Andreasen and Olsen 1982) and found three factors. The additional factor arose from the splitting of positive symptoms into two separate factors defined by (1) delusions and hallucinations and (2) thought disorder, bizarre behavior, and alogia; negative symptoms defined the third factor. A similar three-factor structure has also been reported by Liddle and Barnes (1990). On this basis, a three-factor model of schizotypal personality can be hypothesized as follows: (1) cognitive-perceptual factor (ideas of reference, magical thinking, unusual perceptual experiences, paranoid ideation) and (2) odd behavior factor (social anxiety, no close friends, constricted affect).

<table>
<thead>
<tr>
<th>Factor-analytic structures predicted by the four models</th>
<th>One-factor</th>
<th>Simple two-factor</th>
<th>Kendler two-factor</th>
<th>Three-factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideas of reference</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Magical thinking</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Unusual perceptual experiences</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Paranoid ideation</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Social anxiety</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No close friends</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Constricted affect</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Odd behavior</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Odd speech</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Note.—1 = variables loading on the factor, 0 = zero loading.
noid ideation), (2) interpersonal factor (social anxiety, no close friends, constricted affect, paranoid ideation), and (3) disorganization (odd behavior, odd speech). Loadings for the disorganization factor are predicted on the grounds that odd behavior is the closest schizotypal feature to bizarre behavior in schizophrenia, and odd speech is the closest schizotypal analog to schizophrenic thought disorder.

The main aim of this study is to assess which of five models (null, one-factor, simple two-factor, Kendler two-factor, three-factor) best explains individual differences in schizotypal personality in the general population as assessed by the SPQ. Confirmatory factor analysis using the computer program LISREL was employed because such analysis is generally superior to exploratory factor analysis and is ideal for testing competing models, allowing goodness-of-fit indices to assess the fit of each model to the actual data (Bentler and Bonett 1980; Cole 1987; Lenzenweger et al. 1989).

Method

Subjects. The first sample consisted of 822 (403 male, 384 female, 35 sex unknown) undergraduate students enrolled in an introductory psychology class at the University of Southern California. Students completed the SPQ for course credit. Because this large sample has limited variation in age, ability level, and social class, attempts were made to replicate findings in a second (community) sample of volunteers, which consisted of 102 adults (54 male, 48 female) with a mean age of 29.9 years (standard deviation [SD] = 11.5, range = 18–74). Volunteers were recruited from two sources: (1) passengers waiting for flights at Los Angeles International Airport and (2) residents of a large apartment complex in the San Fernando area of Los Angeles. Refusal rate was 9 percent. Airport subjects were randomly selected from all seated adults who appeared to be waiting for a flight. Although this sample cannot be considered a random sample from the general population, it more closely approximates the general population than college undergraduates do.

SPQ. All subjects completed the SPQ (Raine 1991). Full reliability and validity data are given in Raine (1991). This 74-item self-report questionnaire takes approximately 10 minutes to complete and has been found to have high internal reliability as indicated by Cronbach's alpha (0.91). Convergent validity as assessed by Pearson correlations between the SPQ and other measures of schizotypal personality ranges from 0.59 to 0.81 (Raine 1991). Correlations between the SPQ and scales measuring nonschizotypal forms of abnormal personality were significantly lower than correlations between the SPQ and other scales of schizotypal personality, indicating discriminant validity. Test-retest reliability (Pearson’s r) is 0.82. Criterion validity for the SPQ is indicated by a 0.60 correlation (point-biserial) between SPQ scores and a clinical diagnosis of DSM-III-R schizotypal personality disorder and by a 0.68 correlation (Spearman’s r) between the SPQ and dimensional scores of schizotypal personality disorder derived from diagnostic interviews. The internal reliabilities of the nine SPQ subscales range from 0.71 to 0.78 (Cronbach's α), with a mean of 0.74.

Statistical Procedures, Models, and Goodness-of-Fit Indices.

LISREL. Confirmatory factor analysis was conducted using LISREL 7 (Jöreskog and Sörbom 1989). In confirmatory factor analysis, unlike exploratory factor analysis, a model is constructed a priori that attempts to account for the covariance matrix. For each model proposed, the number of factors and the loadings of variables on specific factors are specified before analysis; ones and zeros are used to specify free loadings and zero loadings, respectively. Confirmatory factor analysis then evaluates these models using goodness-of-fit indices. In contrast, exploratory factor analysis makes no predictions about the underlying factor structure and places no constraints on the number of factors or the factor loadings. Confirmatory factor analysis is thought to represent a stronger and more rigorous approach to the analysis of the underlying factor structure, particularly since it encourages a more hypothetico-deductive approach.

LISREL analyses were conducted on variance-covariance matrices rather than correlation matrices, which tend to give incorrect standard errors, produce incorrect goodness-of-fit values, and result in overfitting (Jöreskog and Sörbom 1989). The main aim of maximum-likelihood confirmatory factor analysis is to assess what underlying latent factors account for covariation within a group of measures. For each model, LISREL compares the estimated covariance matrix to the actual matrix and assesses the match using goodness-of-fit indices.

Models. The four models out-
The one-factor model predicts that all variables will load on a single factor. The simple two-factor model predicts loadings from cognitive-perceptual traits on factor 1 and loadings from interpersonal traits on factor 2, without overlap of loadings between the factors. The Kendler two-factor model differs from the simple two-factor model in that paranoid ideation and social anxiety are predicted to load on both factors, while odd behavior loads on the interpersonal deficit factor (factor 2). The three-factor model differs from the two-factor models in that (1) odd behavior and odd speech are hypothesized to break off from the first, cognitive-perceptual factor to form a third disorganization factor, and (2) paranoid ideation is hypothesized to load on both the first, cognitive-perceptual factor and the second, interpersonal factor. This prediction of loading for paranoid ideation is based on results of exploratory factor analysis of the SPQ from Gruzelier et al. (1991), which indicate that paranoid ideation may also belong to both negative and positive symptom groups. Path diagrams illustrating these four models are displayed in figure 1.

To provide a baseline for comparing these four models, a fifth model, the null model, was also examined. Under this model, each of the nine schizotypal traits is assumed to represent an independent dimension (nine factors in total); that is, there is no underlying structure to schizotypal personality.

Goodness-of-fit indices. Six goodness-of-fit indices were calculated to assess fit of the models. The first, chi-square, indicates a good fit when it is nonsignificant. A major disadvantage of chi-

Figure 1. Path diagrams illustrating the four models

SPD = schizotypal personality disorder. Observed variables are represented by squares, latent factors by circles. Single-headed arrows represent factor loadings; double-headed arrows represent correlations.
square is its sensitivity to sample size: With large samples even models with good fit will be rejected because chi-square is significant; conversely, one can obtain a better fit by simply reducing sample size. Chi-square, therefore, has been regarded as questionable as a reliable goodness-of-fit index (GFI) (Bentler and Bonett 1980; Cole 1987; Marsh et al. 1988; Jöreskog and Sörbom 1989; Bentler 1990). Consequently, five other frequently used indices were used to assess fit as follows:

1. The GFI is analogous to the squared multiple correlation in multiple regression and provides a measure of the amount of variance and covariance explained by the model (Jöreskog and Sörbom 1989). Values greater than 0.90 indicate a good fit (Cole 1987).

2. The adjusted GFI controls for the degrees of freedom in the model and is analogous to the adjusted squared multiple correlation in multiple regression. Values greater than 0.80 indicate a good fit (Cole 1987).

3. The normed fit index (NFI) does not require a statistical basis for model fitting and has been claimed to be independent of sample size. Values greater than 0.90 indicate a good fit (Bentler and Bonett 1980).

4. The Tucker-Lewis index (TLI; Tucker and Lewis 1973) is a non-normed fit index (Bentler and Bonett 1980), which has the important advantage of reflecting model fit very well at all sample sizes (Bentler 1990). McDonald and Marsh (1990) recently found that the TLI is the only one of 30 widely used fit indices that is relatively independent of sample size. Values for AIC vary from large negative values to zero; values closer to zero indicate better fitting models. AIC was calculated according to the formula outlined by Loehlin (1987).

Models are assessed on the extent to which they are associated with acceptable goodness-of-fit indices. By this convergent approach, the more good fits that are obtained with these indices, the more satisfactory the model is deemed to be.

Results

Comparison of Models. Goodness-of-fit indices for the five models are presented in table 2. An asterisk beside a fit index means that its value indicates a good fit (> 0.90 for GFI, NFI, TLI; > 0.80 for adjusted GFI; closest to 0 for AIC). Overall, the three-factor model provides the best fit to the data. The null and one-factor models are rejected because no fit index indicates a good fit (χ² and absolute value of AIC are high, and other indices are low). The simple

Table 2. Goodness-of-fit indices associated with the five models in all subjects

<table>
<thead>
<tr>
<th>Model</th>
<th>χ²</th>
<th>df</th>
<th>p</th>
<th>GFI</th>
<th>Adj. GFI</th>
<th>TLI</th>
<th>NFI</th>
<th>AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate sample (n = 822)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Null</td>
<td>2309</td>
<td>36</td>
<td>0.000</td>
<td>0.52</td>
<td>0.40</td>
<td>—</td>
<td>—</td>
<td>—1163</td>
</tr>
<tr>
<td>One-factor</td>
<td>833</td>
<td>27</td>
<td>0.000</td>
<td>0.78</td>
<td>0.63</td>
<td>0.53</td>
<td>0.64</td>
<td>—425</td>
</tr>
<tr>
<td>Simple two-factor</td>
<td>419</td>
<td>26</td>
<td>0.000</td>
<td>0.89</td>
<td>0.82¹</td>
<td>0.76</td>
<td>0.82</td>
<td>—219</td>
</tr>
<tr>
<td>Kendler two-factor</td>
<td>392</td>
<td>24</td>
<td>0.000</td>
<td>0.91¹</td>
<td>0.83¹</td>
<td>0.76</td>
<td>0.83</td>
<td>—208</td>
</tr>
<tr>
<td>Three-factor</td>
<td>170</td>
<td>23</td>
<td>0.000</td>
<td>0.96¹</td>
<td>0.91¹</td>
<td>0.90¹</td>
<td>0.93¹</td>
<td>—98¹</td>
</tr>
<tr>
<td>Community sample (n = 102)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Null</td>
<td>412</td>
<td>36</td>
<td>0.000</td>
<td>0.42</td>
<td>0.28</td>
<td>—</td>
<td>—</td>
<td>—215</td>
</tr>
<tr>
<td>One-factor</td>
<td>133</td>
<td>27</td>
<td>0.000</td>
<td>0.74</td>
<td>0.56</td>
<td>0.62</td>
<td>0.68</td>
<td>—75</td>
</tr>
<tr>
<td>Simple two-factor</td>
<td>66</td>
<td>26</td>
<td>0.000</td>
<td>0.87</td>
<td>0.77</td>
<td>0.85</td>
<td>0.84</td>
<td>—43</td>
</tr>
<tr>
<td>Kendler two-factor</td>
<td>66</td>
<td>24</td>
<td>0.000</td>
<td>0.87</td>
<td>0.77</td>
<td>0.83</td>
<td>0.84</td>
<td>—45</td>
</tr>
<tr>
<td>Three-factor</td>
<td>36</td>
<td>23</td>
<td>0.023</td>
<td>0.92¹</td>
<td>0.85¹</td>
<td>0.94¹</td>
<td>0.91¹</td>
<td>—32¹</td>
</tr>
</tbody>
</table>

Note.—df = degrees of freedom; GFI = goodness-of-fit index; Adj. GFI = adjusted goodness-of-fit index, NFI = normed fit index; TLI = Tucker-Lewis index; AIC = Akaike information criterion.

¹Value indicates a good fit (> 0.90 for GFI, NFI, TLI; > 0.80 for adjusted GFI; closest to 0 for AIC).
two-factor model had an adjusted GFI of 0.82 in the undergraduate sample, but the remaining nine indices (four in undergraduate sample, five in community sample) failed to indicate a good fit. Therefore, this model can also be discounted. For the Kendler model, only 2 out of 10 fit indices indicated a good fit, and values of all 10 indices were very close to those for the simple two-factor model. This finding indicates that the Kendler model offers no improvement in fit over the simple two-factor model.

The three-factor model produced the best fit to the data because all 10 indices (5 in each of 2 samples) indicated a good fit. All 10 indices were higher for the three-factor model than for its nearest competitors, the simple two-factor model and the Kendler two-factor model. In addition, chi-square values were the lowest for the three-factor model—approximately half the value for the nearest competitor—again indicating a better fit to the data.

### Factor Loadings

LISREL maximum-likelihood Oblimin loadings derived from the three-factor model for the undergraduate and community samples are shown in table 3. In the undergraduate sample, the first factor is defined by substantial loadings (0.47–0.78) from ideas of reference, magical thinking, unusual perceptual experiences, and paranoid ideation, suggesting a latent trait of cognitive-perceptual deficits. The second factor is defined by substantial loadings (0.45–0.77) from social anxiety, no close friends, constricted affect, and paranoid ideation, suggesting a latent trait of interpersonal deficits. The third factor is defined by high loadings (0.62–0.74) from odd behavior and odd speech, suggesting a latent construct of cognitive and behavioral disorganization. All factor loadings were statistically significant ($p < 0.0001$). This factor structure was closely replicated in the community sample, with mean absolute difference in loadings being 0.09 (minimum = 0.04, maximum = 0.15).

The interfactor correlation matrix for the undergraduate and community samples indicated that the pattern of correlations found in the undergraduate sample was replicated in the community sample. Disorganization and cognitive-perceptual deficits were highly correlated ($r = 0.71$ in undergraduates [U], $r = 0.75$ in community [C], $p < 0.0001$), indicating that while they are distinct latent constructs, their variance overlaps by 50 to 56 percent. Disorganization also correlated with interpersonal deficits ($r = 0.44$ [U], $r = 0.60$ [C], $p < 0.0001$), whereas interpersonal deficits and perceptual-cognitive deficits showed correlations of only 0.20 (U) and 0.37 (C) ($p < 0.01$). In the undergraduate sample, the correlations between disorganiza-

### Table 3. LISREL maximum-likelihood Oblimin loadings from the three-factor model for the undergraduate sample and community sample

| Cognitive-perceptual (factor 1) | | | Interpersonal (factor 2) | | | Disorganization (factor 3) | | |
|---------------------------------|---------|---------|--------------------------|---------|---------|--------------------------|---------|
|                                 | U       | C       | U                       | C       | U       | C                        | U       | C       |
| Ideas of reference              | 0.75    | 0.83    | 0.00                     | 0.00    | 0.00    | 0.00                     | 0.00    | 0.00    |
| Magical thinking                | 0.62    | 0.53    | 0.00                     | 0.00    | 0.00    | 0.00                     | 0.00    | 0.00    |
| Unusual perceptual experiences  | 0.78    | 0.74    | 0.00                     | 0.00    | 0.00    | 0.00                     | 0.00    | 0.00    |
| Paranoid ideation               | 0.47    | 0.56    | 0.45                     | 0.41    | 0.00    | 0.00                     | 0.00    | 0.00    |
| Social anxiety                  | 0.00    | 0.00    | 0.58                     | 0.66    | 0.00    | 0.00                     | 0.00    | 0.00    |
| No close friends                | 0.00    | 0.00    | 0.77                     | 0.89    | 0.00    | 0.00                     | 0.00    | 0.00    |
| Constricted affect              | 0.00    | 0.00    | 0.76                     | 0.81    | 0.00    | 0.00                     | 0.00    | 0.00    |
| Odd behavior                    | 0.00    | 0.00    | 0.00                     | 0.00    | 0.62    | 0.49                     | 0.74    | 0.88    |
| Odd speech                      | 0.00    | 0.00    | 0.00                     | 0.00    | 0.74    | 0.88                     | 0.00    | 0.00    |

Note.—U = undergraduate, C = community sample. All factor loadings are statistically significant ($p < 0.0001$).
tion and the other two factors \( r = 0.71, 0.44 \) were both significantly higher than the 0.20 correlation between perceptual-cognitive and interpersonal \( z = 13.8, 5.4; p < 0.0001 \). This finding was replicated in the community sample \( z = 4.1, p < 0.0001; z = 2.1, p < 0.02 \).

To summarize, while disorganization represents a third factor defined by only two loadings, it is central to the construct of schizotypal personality, as indicated by its moderate to large \( 0.75, 0.71, 0.60, 0.44 \), significant correlations with the other two factors. In contrast, the other two factors correlated at significantly lower levels \( 0.20, 0.37 \) and appear to represent more independent dimensions.

Sex Differences. Because sex differences have been reported for schizotypal personality in the normal population (Chapman et al. 1976; Raine 1992), data for the largest sample were divided into male \( n = 403 \) and female \( n = 384 \) subsamples and confirmatory factor analyses recalculated to assess whether support for the three-factor model is specific to males or females. For both sexes, the three-factor model again provided the best fit to the data. Fit indices were as follows: GFI, 0.96 females, 0.94 males; adjusted GFI, 0.92 females, 0.89 males; NFI, 0.93 females, 0.90 males; TLI, 0.93 females, 0.88 males; AIC, −47 females, −68 males. These data indicate that the three-factor model receives relatively equal support in males and females. No sex differences were apparent for factor loadings. All loadings were substantial \( 0.49-0.89 \), with the mean absolute shift in loadings from males to females being 0.08 \( (\text{minimum} = 0.02, \text{maximum} = 0.15) \). Full details on these data are available upon request.

Factor Structure in Nonschizotypals. Although subjects were not drawn from clinical samples, it is possible that the observed factor structure is largely determined by high-scoring SPQ subjects, who are likely to have a clinical diagnosis of schizotypal personality disorder. For example, 55 percent of subjects scoring in the top 10 percent of SPQ scores have been found to receive a clinical diagnosis of schizotypal personality disorder (Raine 1991). This finding yields a base rate of 5.5 percent, a value similar to the 5.8 percent reported by Baron and Risch (1987). Consequently, if the top 10 percent of SPQ scores were excluded, the majority of schizotypal subjects in the sample would probably also be excluded. To assess the possibility that results are specific to subjects with high SPQ scores, confirmatory factor analysis was rerun on subjects scoring in the bottom 90 percent of SPQ scorers, who are less likely to have a clinical disorder. Cutoff values were 40 for the undergraduate sample and 38 for the community sample.

Results were very close to those reported for the full sample in table 2 (full details are available upon request). The three-factor model was again found to provide the closest fit to the data, with 8 of the 10 fit indices indicating a good fit. Of 10 fit indices, 2 again indicated a fit for the Kendler two-factor model, and only 1 index again indicated a fit for the simple two-factor model. The null and one-factor models were again poor fits to the data, as indicated by all indices showing a lack of fit. These analyses indicate that the three-factor structure is not specific to subjects with high scores on the SPQ but exists throughout the range of schizotypal values found in normal populations.

Discussion

The results support the notion that three factors underlie individual differences in schizotypal personality in the general population. The three-factor model appears to fit the data better than other models in the undergraduate sample, and this finding was replicated in the community sample, indicating that this finding is not specific to young, advantaged populations. These findings are also consistent with an unpublished report of three factors underlying the SPQ, derived from an exploratory factor analysis of an English normal sample with the same loadings predicted by the three-factor model (Gruzelier et al. 1991). Because the models were not nested, however, statistical comparisons between competing models were not possible. Therefore, it cannot be claimed that the three-factor model provided a significantly better fit than other models.

One implication of these findings is that the notion of two factors underlying schizotypal personality (Gunderson et al. 1983; Widiger et al. 1986; American Psychiatric Association 1987; Kendler et al. 1991) may require some revision. The simple two-factor model and the Kendler model did not provide a good fit to the data. This lack of fit may have implications for researchers who, assuming a two-factor model of schizotypal personality, have sought differential correlates of cognitive-perceptual and interpersonal features such as sex differences, mixed handedness,
poor attention, and poor eye tracking (Siever et al. 1984, 1990; Siever 1985; Grove et al. 1991; Kendler et al. 1991; Kim et al. 1992; Raine 1992). Such searches will be inaccurate if three factors underlie schizotypal personality. Future research on mechanisms underlying schizotypal personality should seek correlates of three latent factors of schizotypal personality, in addition to the more traditional two latent factors, to produce more consistent and clear-cut findings.

A second implication of the present results is that they provide mixed support for notions that a single vulnerability dimension underlies schizotypal personality (Meehl 1962, 1989; Grove et al. 1991). Grove et al. (1991) found that a variety of putative schizotypal indicators (questionnaire and interview measures of schizotypal personality, eye-tracking abnormalities, and continuous performance task deficits) run in families and are intercorrelated, and furthermore that these indicators are genetically correlated. On this basis, they argued that a single core dimension contributed to variation in these indicators. Such a conclusion would predict that either a single factor or multiple, highly correlated factors underlie schizotypal personality. The one-factor model of schizotypal personality did not fit the data, ruling out the first possibility. Regarding the second possibility, the three-factor model, which produced the closest fit to the data, included two factors (cognitive-perceptual and interpersonal deficits) that shared only 4 to 14 percent of their variances \( r = 0.20, 0.37 \), a finding consistent with the fact that two similar factors found by Kendler et al. (1991) were derived from an orthogonal (uncorrelated) Varimax rotation. Because the single-dimension model must predict high correlations between the three factors, these data are partly inconsistent with the notion of a single core vulnerability factor for schizotypal personality. Rather, if some latent factors of schizotypal personality are largely uncorrelated, it seems more likely that they are determined by multiple, independent processes. A similar conclusion is drawn from symptoms of schizophrenia by Lenzenwegher et al. (1989), who found significantly stronger support for the model of Crow (1985), in which positive and negative symptoms reflect independent pathological processes that can coexist in the same individual, than for two models predicting a unidimensional structure.

Some limited support for the single vulnerability dimension proposed by Grove et al. (1991) is suggested, however, by the fact that disorganization correlated at moderate to high levels with cognitive-perceptual deficits \( r = 0.71, 0.75 \) and interpersonal deficits \( r = 0.44, 0.60 \). These correlations show that some of the factors overlap. If there is a major vulnerability factor for schizotypal personality, therefore, disorganization may be central to this factor. Paradoxically, there has been no research into this factor of schizotypal personality, though it would seem important for future studies to examine correlates of this schizotypal factor in both clinical and nonclinical samples.

A third implication of these data may be viewed in the context of recent revisions of the structure of schizophrenic symptomatology. Specifically, the three factors found to underlie schizotypal personality in this study may have some bearing on the three factors underlying schizophrenic symptomatology (Arndt et al. 1991). The cognitive-perceptual schizotypal factor (made up of unusual perceptual experiences, magical thinking, paranoid ideation, and ideas of reference) may be analogous to the positive symptoms factor (delusions and hallucinations) found by Arndt et al. (1991) in schizophrenia. The interpersonal factor may be a schizotypal analog to the more negative symptoms factor in schizophrenia patients, although social anxiety, which loads on this factor, has no clear analog in positive or negative schizophrenic symptoms. The disorganization factor (odd speech and odd behavior) may be a schizotypal analog to the third schizophrenic factor of Arndt et al. (1991), which is made up of thought disorder and bizarre behavior.

To the extent that these analogies are valid, the three factors of schizotypal personality in the normal population may help explain three factors of schizophrenic symptomatology. It may be, for example, that the three-factor structure found in schizophrenia represents an exaggeration of the same factor structure found in the normal population. To the extent that the structure of schizophrenic symptomatology has its roots in the same factor structure in the normal population, research into individual differences in schizotypal personality in nonclinical populations may inform our understanding of the etiology of schizophrenic symptomatology (Siever 1985; Holzman et al. 1988; Nuechterlein 1990; Kendler et al. 1991). For example, a three-stage model may exist whereby individual difference factors in schizotypal personality in the normal popula-
tion provide the foundation for similar factors of schizotypal personality at the clinical level, which then provide the basis for factors of schizophrenic symptomatology. When mechanisms that underlie individual differences in odd speech and odd behavior (the disorganization factor) in the normal population become mildly dysfunctional, they may give rise to odd speech and odd behavior at the clinical, schizotypal level, while a still greater level of dysfunction may give rise to the disorganized or bizarre behavior observed in schizophrenia. Research into the mechanisms underlying individual differences in schizotypal factors in normal subjects may therefore yield valuable insights into key dysfunctional systems involved in schizophrenia. It should be emphasized that this suggestion is only a tentative hypothesis at this stage. Further, it should be noted that schizotypal personality disorder may differ in important ways from schizophrenia with respect to interrelationships between symptom and social factors, rather than representing merely a milder version of schizophrenia.

It should be reemphasized that findings of this study relate specifically to individual differences in schizotypal personality in the community and cannot at this stage be generalized to schizotypal personality disorder in clinical samples. Because confirmatory factor analysis depends on large sample sizes, and because samples of clinical schizotypal subjects have to date been small, these initial findings are necessarily based on a large sample of nonclinical subjects. A further caveat is that no conclusions can be drawn from these data regarding whether liability to schizotypal personality disorder is categorical or dimensional. Kendler et al. (1991), among others, have argued for a dimensional approach based on data from normal twins, and the notion that factors of schizophrenic symptoms have their origins in factors of schizotypal personality in the general population would be consistent both with this view and with the notion of a continuous and normal distribution of genetic liability to schizophrenia-spectrum disorders (Gottesman and Shields 1982). Nevertheless, a categorical model of schizotypal personality is not counterindicated by the present data. Because goodness-of-fit indices do not themselves demonstrate external validity for a model, it is important that the three-factor model be further tested to assess factorial validity.

Finally, one important conceptual issue concerns whether schizotypal signs can be measured by self-report methodology. Validity data for sign subscales were found to be just as good as those for symptom subscales (Raine 1991), indicating that subjects who rated themselves as having constricted affect were also rated as having constricted affect by a clinical rater blind to self-report scores. Construct validity has also been obtained for these subscales in two recent studies (Kim et al. 1992; Raine 1992). Validity data for self-report on signs may be good because schizotypal personality disorder may involve less loss of insight than more serious psychiatric disorders. The success in measuring schizotypal signs may also be due to the wording of some questions relating to signs, which asked the subject to report on comments from others—for example, “People sometimes find me aloof and distant” for the sign of constricted affect.

In conclusion, three latent factors—cognitive-perceptual deficits, interpersonal deficits, and disorganization—appear to underlie schizotypal personality in the normal population. This factor structure is replicable and provides the closest fit to the data relative to null, one-factor, and two-factor models. It is hypothesized that a similar three-factor structure of schizophrenic symptomatology may represent an exaggeration of a similar factor structure found in the normal population.

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