Psychometric Detection of Schizotypy: Perceptual Aberration and Physical Anhedonia in Relatives of Schizophrenics

Brett A. Clementz, William M. Grove, Joanna Katsanis, and William G. Iacono
University of Minnesota

We administered scales of Perceptual Aberration (PERAB) and Physical Anhedonia (PHYSAN), traits that may be related to risk for schizophrenia, to 54 schizophrenics, 146 of their first-degree relatives (evaluated for schizophrenia-related disorders), and 178 normal subjects (screened for psychotic disorders in them or their relatives). For both scales, there was a significant effect of group membership. For the PERAB scale, the schizophrenics had higher scores than the normal subjects, who had higher scores than the relatives. For the PHYSAN scale, schizophrenics had higher scores than their relatives, who had higher scores than the normal subjects. Patterns of familial correlations also suggested that physical anhedonia, but not perceptual aberration, may be familial among schizophrenics and their relatives. The PHYSAN scale, but not the PERAB one, may be a useful indicator of liability for schizophrenia among the relatives of affected probands.

In a series of publications, Chapman and Chapman, in collaboration with their colleagues, have developed a set of questionnaires for measuring facets of Meehl’s (1990) formulation of a schizotypy syndrome (see Chapman & Chapman, 1985, and Grove, 1982, for reviews). Perhaps the most promising and frequently researched of such scales have been Perceptual Aberration (PERAB; Chapman, Chapman, & Raulin, 1978) and Physical Anhedonia (PHYSAN; Chapman, Chapman, & Raulin, 1976). Initial evidence that these scales, especially PERAB, may identify persons at risk for schizophrenia was promising (Grove, 1982), a conclusion supported in two recent articles by Lenzenweger and Loranger (1989a, 1989b). Other research, however, has suggested that PERAB and PHYSAN may be related to risk for general psychopathology (perhaps psychosis), not just risk for schizophrenia (Chapman & Chapman, 1985; Katsanis, Iacono, & Beiser, 1990).

If these scales are related to schizophrenia risk, then at least a subset of schizophrenics’ first-degree relatives ought to have higher PERAB and PHYSAN scores than persons screened for the absence of psychotic disorders in either themselves or their first-degree relatives. We tested this hypothesis in a large sample of schizophrenics’ first-degree relatives and nonpsychiatric comparison subjects. Because the first-degree relatives were also evaluated for the presence of schizophrenia-related disorders, we were also able to determine if there was a direct relationship between affection and PERAB and PHYSAN scale scores.

Method

Subjects

The subjects for this study came from three separate samples collected for the purpose of identifying marker variables for schizophrenia risk (New York sample, Clementz, Sweeney, Hirt, & Haas, 1990, in press; Minneapolis sample, Grove et al., 1991; and Vancouver sample, Katsanis et al., 1990). The probands (n = 78) qualified for a Diagnostic and Statistical Manual for Mental Disorders (3rd ed.; DSM-III; American Psychiatric Association, 1980) diagnosis of schizophrenia. The Minneapolis and Vancouver sites contributed 16 and 38 probands, respectively. Although 24 probands were identified in New York, these persons were not administered the questionnaires and therefore are not considered further.

All available first-degree biological relatives of these probands (n = 246) were contacted, and 160 of them (65%) agreed to participate (see Clementz et al., 1990, in press; Grove et al., 1991; and Katsanis et al., 1990, for full details of inclusion and exclusion criteria for relatives). At all three sites, relatives were recruited directly by project staff. Of the 72 eligible relatives identified in New York, 51 (68%) completed questionnaires, and 53 of 89 (60%) completed questionnaires in Minneapolis. The Vancouver sample was unlike the other two, which were recruited as part of family studies of schizophrenia. The Vancouver probands were recruited as part of an epidemiological investigation designed to identify all cases of first-episode psychosis in a designated metropolitan catchment area. Hence, to be included in the study, it was not necessary for probands to have available relatives. Twelve probands had no biological relatives living in the area. Another 10 had 22 available relatives, but either the proband refused to grant us permission to contact the relatives or the relatives refused to participate. The remaining 22 probands had 63 available relatives, 44 of whom (70%) completed the questionnaires. Thus, of the total of 83 relatives available at the Vancouver site, 52% participated in this study.

Vancouver yielded the smallest ratio of available relatives for each proband. This occurred in large part because, unlike the probands at
the other sites who represent older, more chronic patients, the Vancouver probands were first-episode cases, over 40% of whom were under 21 years old. As a consequence of the young age of the Vancouver probands, they had fewer eligible siblings because many of their siblings were too old enough to give legal consent to participate in the study.

Nonpsychiatric comparison subjects (N = 178) were screened for the absence of psychiatric illness and previous psychiatric treatment in both themselves and their first-degree relatives. The Minneapolis sample contributed 18 and the Vancouver sample contributed 160 nonpsychiatric comparison subjects. All subjects provided written informed consent before participation. Only data from subjects who were actually seen in the laboratory were used. Demographic characteristics of the subjects are summarized in Table 1.

Procedure

The subjects were administered the PERAB and PHYSAN scales, randomly distributed among other questionnaire items, as part of extensive evaluation procedures. Additionally, all relatives were assessed for the presence of schizophrenia with either the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1981) or the Structured Clinical Interview for DSM-III (Spitzer, Williams, & Gibbon, 1987). Five relatives qualified for a DSM-III schizophrenia diagnosis, which yielded a morbid risk estimate (Gottesman, Shields, & Hanson, 1982, pp. 20–21) of 4.27%, a figure consistent with the rate of schizophrenia among the relatives of DSM-III probands from other studies (Coryell & Zimmerman, 1988). For two of the samples (Clementz et al., 1990, in press; Grove et al., 1991), the relatives were also evaluated for the presence of schizophrenia-related personality disorders with the Schedule for Schizotypal Personalities (Baron, Asnis, & Grueen, 1981). Twelve of 104 relatives (11.5%) so evaluated qualified for a schizophrenia-related personality disorder diagnosis (they unequivocally met criteria for 4 of the 10 Schedule for Schizotypal Personalities scales), which is consistent with Baron et al.'s (1985) 14.6% figure. All evaluations were conducted by trained personnel (psychologists or psychiatrists) with considerable experience in using the interviews.

Results

Data Analysis

PERAB was markedly positively skewed and demonstrated similarity of coefficients of variation and significant heterosce-

dasticity across groups (Bartlett-Box F = 22.53, p < .001). As a result, logarithmically transformed PERAB scores (Bartlett-Box F = 0.77, p > .05) were used to test for group differences (the results with untransformed data, however, were the same). All effect size estimates (δ) were calculated with pooled standard deviation estimates and the nonpsychiatric comparison group as the referent (Glass & Hopkins, 1984, p. 236). A Group (nonpsychiatric comparison, relatives, and probands) X Gender analysis of variance (ANOVA), followed by post hoc Tukey-Kramer honestly significant difference tests (familywise α = .05), was used to test for group differences.

Intercorrelation of Age, Perceptual Aberration, and Physical Anhedonia

Pearson product-moment correlations were calculated between age, PERAB, and PHYSAN separately for the probands, relatives, and nonpsychiatric comparison subjects. For all of the groups, the correlations between PERAB and PHYSAN were nonsignificant: for probands, r(54) = .09, for relatives, r(148) = −.01, and for normals, r(178) = −.03. The correlations for all groups between PHYSAN and age were also nonsignificant. For the normal control subjects, however, but for neither the probands, r(54) = −.01, nor their relatives, r(148) = .01, there was a significant association between age and PERAB, r(178) = −.27, p < .001; this result demonstrates that age accounted for 7% of PERAB score variance among the normal control subjects. Because subsequent PERAB group comparisons with age as a covariate yielded the same results as those calculated without age as a covariate, only the latter will be reported.

Perceptual Aberration, Physical Anhedonia, and Schizophrenia Risk

We initially analyzed the data for location differences (New York, Minneapolis, and Vancouver) on the questionnaire measures. The t tests to compare the Minneapolis and Vancouver normal and proband samples for both PERAB (t < 1.64) and PHYSAN (t < 0.78) were nonsignificant. A one-way ANOVA to compare the Minneapolis, New York, and Vancouver relative

<table>
<thead>
<tr>
<th>Group</th>
<th>Age M</th>
<th>Age SD</th>
<th>Women %</th>
<th>PERAB M</th>
<th>PERAB SD</th>
<th>PHYSAN M</th>
<th>PHYSAN SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizophrenic</td>
<td>26.0</td>
<td>7.5</td>
<td>22</td>
<td>6.3</td>
<td>6.2</td>
<td>14.3</td>
<td>7.2</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>31.2</td>
<td>9.2</td>
<td>25</td>
<td>7.4</td>
<td>7.5</td>
<td>14.4</td>
<td>5.7</td>
</tr>
<tr>
<td>Vancouver</td>
<td>23.8</td>
<td>6.6</td>
<td>21</td>
<td>5.8</td>
<td>5.7</td>
<td>14.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Relatives</td>
<td>42.5</td>
<td>14.2</td>
<td>57</td>
<td>2.5</td>
<td>3.2</td>
<td>11.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>39.7</td>
<td>13.3</td>
<td>60</td>
<td>2.2</td>
<td>3.4</td>
<td>13.3</td>
<td>4.9</td>
</tr>
<tr>
<td>Vancouver</td>
<td>44.3</td>
<td>19.3</td>
<td>52</td>
<td>2.5</td>
<td>2.8</td>
<td>11.1</td>
<td>5.8</td>
</tr>
<tr>
<td>New York</td>
<td>43.9</td>
<td>15.8</td>
<td>57</td>
<td>2.3</td>
<td>3.0</td>
<td>9.9</td>
<td>5.7</td>
</tr>
<tr>
<td>Nonpsychiatric</td>
<td>35.3</td>
<td>17.6</td>
<td>55</td>
<td>3.8</td>
<td>4.2</td>
<td>8.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Minneapolis</td>
<td>35.3</td>
<td>17.6</td>
<td>55</td>
<td>3.8</td>
<td>4.2</td>
<td>8.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Vancouver</td>
<td>32.5</td>
<td>14.7</td>
<td>56</td>
<td>4.1</td>
<td>5.0</td>
<td>8.1</td>
<td>5.5</td>
</tr>
</tbody>
</table>
groups on PERAB was also nonsignificant, \( F(2, 145) = 0.78 \). A one-way ANOVA to compare the relative groups on PHYSAN, however, was significant, \( F(2, 145) = 5.36, p < 0.05 \). Post hoc comparisons demonstrated that the Minneapolis sample relatives had higher PHYSAN scores than the New York sample relatives but that neither of these groups significantly differed from the Vancouver sample relatives on PHYSAN (see Table 1).

Given the great similarity of scores across samples, therefore, pooling these data for group comparison purposes seemed reasonable.

There was an effect for group membership on PERAB, \( F(2, 377) = 21.32, p < 0.001 \). Neither the gender main effect, \( F(1, 378) = 2.05 \), nor the Group X Gender interaction effect, \( F(2, 377) = 0.25 \), was significant. All three groups significantly differed, with the schizophrenics’ relatives having the lowest PERAB scores (\( \bar{\Delta} = -0.30 \)), followed by the normal control subjects and the schizophrenic probands (\( \bar{\Delta} = 0.59 \); see Figure 1, Panels a and b, and Table 1). To determine if there was a relation between PERAB and affection in the relatives, a logistic regression analysis of a schizophrenia-related disorder diagnosis (schizophrenia or a schizophrenia-related personality disorder, coded as affected or unaffected) on PERAB for the relatives was conducted. This analysis was significant, \( \chi^2(1, N = 148) = 5.50, p = 0.019 \), which suggests that relatives with higher PERAB scores were more frequently diagnosed with a schizophrenia-related disorder. Because it may be argued that only a subset of the relatives were actually evaluated for schizophrenia-related personality disorders and that the logistic regression may have been biased as a result, we also performed this same analysis with only the 104 relatives who were so interviewed, and the result was the same, \( \chi^2(1, N = 104) = 5.05, p = 0.025 \). The increase in the log odds ratio associated with a unit change in PERAB was 0.16. To further evaluate this relation, we compared the PERAB scores of the 17 relatives with a schizophrenia-related disorder with both the unaffected relatives and the probands. The overall ANOVA was significant, \( F(2, 199) = 19.55, p < 0.001 \). Post hoc comparisons demonstrated that the PERAB mean for the unaffected relatives (\( M = 2.2, SD = 3.0 \)) was significantly less than means for both the affected relative (\( M = 4.2, SD = 3.5 \)) and proband groups, who did not significantly differ.

There were main effects for group membership, \( F(2, 377) = 23.12, p < 0.001 \), and gender, \( F(1, 378) = 12.52, p < 0.001 \), on PHYSAN. The Group X Gender interaction effect, however, was not significant, \( F(2, 377) = 0.82 \). Men (\( M = 12.0, SD = 6.4 \)) had higher PHYSAN scores than women (\( M = 9.2, SD = 5.8 \)). Again, all three groups significantly differed, with the normal subjects having the lowest score, followed by the relatives (\( \bar{\Delta} = 0.60 \)) and the probands (\( \bar{\Delta} = 1.13 \); see Figure 1, Panels c and d, and Table 1). Logistic regression analysis of a schizophrenia-related disorder diagnosis on PHYSAN for the relatives, however, was not significant, \( \chi^2(1, N = 148) = 0.11 \). As with PERAB, we also performed this analysis with only the 104 relative sample, and again, the result was the same, \( \chi^2(1, N = 104) = 0.14 \). Similarly, the mean PHYSAN scores for the affected (\( M = 11.0, SD = 5.1 \)) and unaffected (\( M = 11.5, SD = 5.7 \)) relatives did not significantly differ.

**Familial Correlations**

To investigate the pattern of relative resemblance for PERAB and PHYSAN, parental (i.e., parents of the schizophrenic probands), offspring-parent, and sibling-sibling correlations were calculated (all probands who completed the questionnaires were both offspring and siblings and were included in these analyses) with the method of maximum likelihood by the FORTRAN program PECOR (Division of Biostatistics, Washington University School of Medicine). Briefly, PECOR is a general method for calculating familial resemblance for quantitative traits even when family structures are not of uniform size. The correlational structure is specified to be intraclass or within groups (e.g., sibling-sibling correlations are intraclass) and interclass or between groups (e.g., parental correlations and offspring-parent regressions are interclass). This method has been found to be relatively unbiased and efficient, even when the data are highly nonnormal (see Rao, Vogler, McGuie, & Russell, 1987, and Vogler, Wette, McGuie, & Rao, 1987, for further details). Only those families in which there were at least 2 persons with questionnaire scores were used (\( n = 52 \)). The significance of correlations was determined with standard likelihood ratio tests. The methods for calculating relative resemblance for quantitative traits and their rationale are clearly detailed in Falconer (1989, pp. 148–161).

For PERAB, the parental \( (r = .27) \), \( \chi^2(1, N = 18 \text{ parental pairs}) = 1.1, \text{offspring-parent } (r = .01) \), \( \chi^2(1, N = 130 \text{ offspring-parent pairs}) = 0.01 \), and sibling-sibling (intraclass \( r = .09 \), \( \chi^2(1, N = 103 \text{ siblings in } 47 \text{ families}) = 0.65 \), correlations were not significant. For PHYSAN, neither the parental, \( (r = .09) \), \( \chi^2(1, N = 18 \text{ parental pairs}) = 0.04 \), nor the offspring-parent \( (r = -.14) \), \( \chi^2(1, N = 130 \text{ offspring-parent pairs}) = 3.06 \), correlations were significant. The sibling-sibling correlation for PHYSAN, however, was significant (intraclass \( r = .50 \), \( \chi^2(1, N = 103 \text{ siblings in } 47 \text{ families}) = 10.08, p < 0.05 \). There were no gender differences in the familial correlations for PHYSAN.

**Discussion**

Contrary to our expectation, relatives of schizophrenic probands had lower PERAB scores than the normal control subjects, and the PERAB scale did not demonstrate familial resemblance in these subjects. There was a significant association between schizophrenia-related disorder diagnoses and PERAB scores in the relatives. This relation, however, only demonstrated that affected relatives (who did not differ from the schizophrenic probands) scored higher on PERAB than both unaffected relatives and normal subjects. PERAB, therefore, may contribute little beyond affection status to identify relatives at risk for schizophrenia. The schizophrenic probands’ mean PERAB score was only 0.59 standard deviation units above the nonpsychiatric comparison group mean, a figure consistent with previously reported effect size estimates (see Grove, 1982, p. 34). A variable with roughly 38% overlap between nonpsychiatric comparison subjects and affected persons may not be an optimal tool for detecting an at-risk population.

Lenzenweger and Loranger (1989a, 1989b) have suggested, from the study of nonpsychotic patients, that PERAB may be a specific liability indicator for schizophrenia. The results of our investigation with schizophrenics’ relatives does not support this conjecture. Clementz et al. (in press) found that PERAB was substantially correlated with cognitive-perceptual, \( r(51) = .30 \), but not social-interpersonal, \( r(51) = .08 \), schizophrenia-re-
Figure 1. Distribution of the untransformed Perceptual Aberration (Panels a and b) and Physical Anhedonia (Panels c and d) scales scores for the schizophrenic probands, their first-degree relatives, and the nonpsychiatric comparison subjects.
lated characteristics in the relatives of schizophrenics. Grove et al. (1991) also found that social-interpersonal, but not cognitive-perceptual, schizophrenia-related characteristics significantly differentiate schizophrenia's relatives from nonpsychiatric comparison subjects. Cognitive-perceptual characteristics are neither unique to schizophrenia (Pope & Lipinski, 1978) nor helpful as sole proband diagnostic criteria in genetic analyses of this disorder (Gottesman et al., 1982). Gunderson and Siever (1985) have also suggested that social-interpersonal features are more closely related to a genetic predisposition for schizophrenia than cognitive-perceptual (e.g., PERAB-like) features.

PERAB may help to identify persons among nonpsychotic proband and relative groups who are at risk for disorders with prominent cognitive-perceptual-type symptoms (a conclusion that is supported by many previous studies; see Chapman & Chapman, 1985). PERAB does not, however, appear to be an indicator of liability for schizophrenia among families ascertained through a proband affected with this disorder. Katsanis et al. (1990) suggested that this may be the result of a defensive response set among schizophrenics' relatives. Such a response set may not exist if subjects with schizophrenia relative were unaware that their selection was contingent on the psychiatric status of a family member. Our results may have little bearing, therefore, on the use of this scale in unselected populations (i.e., college students and nonpsychotic psychiatric patients).

It may be argued that the low scores relatives obtained on the PERAB scale are attributable to biased sampling. This possibility cannot be ruled out, but several factors render it unlikely. First, the rates of schizophrenia and related personality disorders in our relatives are highly similar to those obtained by other investigators who have used similar diagnostic criteria. Second, if our samples included mostly healthy relatives, the pattern of PHYSAN scores across groups might be expected to parallel the PERAB results, which was not the case. Third, despite some variability across sites in the proportion of participating relatives, there were no significant site differences on PERAB, which suggests that scores were not a function of relative refusal rate. Finally, essentially identical PERAB scores were generated across three sites from different geographical locations in two countries.

Unlike PERAB, PHYSAN differentiated both schizophrenic probands and their relatives from comparison subjects, with the probands demonstrating only a 28% overlap with the latter group. Siblings, but not offspring and parents, demonstrated significant similarity on PHYSAN scores. This pattern of familial correlations may indicate that shared environmental rather than genetic factors accounted for the significant sibling-sibling correlation. Segregation analysis will be needed to address this hypothesis.

Despite the fact that affected relatives did not significantly differ from unaffected relatives on PHYSAN (for neither their means nor standard deviations), this variable may still have some theoretical and practical utility. Meehl (1990), although he placed less emphasis on hedonic capacity in the present version of his theory, maintained that hypohedonia, through a complicated path that includes a genetic predisposition and a multitude of other "polygenic potentiators" (i.e., many variables that in a small incremental fashion, either facilitate or inhibit the development of schizophrenia-related symptoms; see Meehl, 1990, p. 27), ought to be more common in schizophrenics and the relatives of schizophrenics than in the general population. This conjecture is consistent with our results. Given the likely polygenic nature of hedonic capacity, however, it is not expected, in isolation (especially when measured by questionnaire alone), to necessarily demonstrate a strong main effect for diagnostic status among schizophrenics' relatives. When used in combination with other variables that demonstrate a similar pattern of results, however, PHYSAN may be a useful indicator of liability for schizophrenia.

References

schizophrenia using a psychometric measure of schizotypy. *Archives of General Psychiatry* 40, 902–907.


Received August 20, 1990
Revision received April 3, 1991
Accepted April 4, 1991

---

**Correction to Wonderlich and Swift (1990)**

In the article, “Perceptions of Parental Relationships in the Eating Disorders: The Relevance of Depressed Mood,” by Stephen A. Wonderlich and William J. Swift (*Journal of Abnormal Psychology* 1990, Vol. 99, No. 4, pp. 353–360), the intrapsychic surface in Figure 1 was incorrectly labeled on Clusters 6 and 8. A corrected figure appears herewith.

Also, in Table 2 the coefficients for "Father controls me" ought to be -.06 for the bulimic–anorexic diagnostic group and .15 for the bulimic diagnostic group. These corrections do not alter any of the results or conclusions of the study.

**INTRAPSychIC**