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The Premorbid Adjustment Scale as a Measure of Developmental Compromise in Patients with Schizophrenia and their Healthy Siblings

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Abstract

Schizophrenia is associated with subtle developmental compromise, but the degree to which this is also associated with heritability and genetic risk is uncertain. The goal of the current study was to investigate the childhood, adolescent, and early adulthood social and academic function of patients with schizophrenia, their healthy siblings, and normal controls, using the Premorbid Adjustment Scale (PAS). Generalized Estimating Equations were conducted to account for nesting of subjects within families. Patients (N=286) scored significantly worse than their healthy siblings (N=315) at every age period; siblings scored significantly worse than controls (N=261) at every age period. In probands, PAS scores got worse after early adolescence while control and proband scores improved after late adolescence. Furthermore, patient PAS scores significantly predicted the scores of their own discordant siblings in childhood and late adolescence. This effect approached significance in early adolescence and in the general scale. Thus, the most premorbidly impaired patients tended to have non-ill siblings with worse premorbid adjustment scores than the siblings of less impaired probands. The results suggest that both patients and many of their siblings share poor adjustment in childhood and adolescence, possibly due to shared genetic or environmental risk factors.

Keywords

Schizophrenia; Premorbid Adjustment Scale; Premorbid; Siblings

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1. Introduction

1.1 Background

There is abundant evidence that at least some individuals who develop schizophrenia as adults demonstrate signs of subtle neurodevelopmental compromise long before the illness becomes evident. This evidence has emerged from the direct study of children born to mothers with schizophrenia (Fish et al., 1992), studies of home movies of those who later develop the illness (Walker & Lewine, 1994), and the study of developmental milestones and school achievement in birth cohorts (Jones et al., 1994; Isohanni, et al., 1994).

Abnormalities of premorbid social behavior and academic performance can be seen as reflections of some of these neurodevelopmental problems. Such abnormalities have previously been described in discordant monozygotic twins and in non-ill children of mothers with schizophrenia [including as measured with the Premorbid Adjustment Scale (Dworkin et al., 1991; Reichenberg et al., 2000)]. There is also a substantial literature demonstrating an association between various cognitive abilities in childhood and the development of illness in adulthood (e.g. Reichenberg et al., 2006; Smith et al., 2006; Sorensen et al., 2006). Moreover, there is evidence that high scores on self report measures of social anhedonia may be related to increased risk for schizophrenia or to other intermediate phenotypes linked to schizophrenia (Gooding, et al., 2005; Gooding et al., 2006; Blanchard et al., 2000). Retrospective rating scales designed to measure these differences in social and academic function have proven useful.

1.2 The Premorbid Adjustment Scale

One of the most widely used retrospective rating scales is the Premorbid Adjustment Scale [PAS] (Cannon-Spoor et al., 1982), which assesses the “degree of achievement of developmental goals” over the course of childhood, adolescence, and where applicable, adulthood. The scale is divided into a general scale and four distinct developmental age periods —childhood to age 11, early adolescence to age 15, late adolescence to age 18, and adulthood. Individual items in the childhood and adolescence categories assess premorbid adjustment by asking about sociability and social withdrawal, peer relationships, scholastic performance, adaptation to school, and ability to form socio-sexual relationships. Ratings in the adult period focus on social relationships while the General Scale ratings are broader, including educational achievement, social relationships, level of interest in and enjoyment of major life activities (work, family, etc). While retrospective reports from patients about their childhood and developmental adjustment may be subject to a variety of biases, there is an impressive body of data suggesting that premorbid adjustment and PAS ratings, specifically, are related to important clinical features of the illness. For example, subjects with poor premorbid adjustment have been shown to have more negative symptoms and a more unremitting course of illness (Bailer, Brauer, & Rey, 1996), longer duration of hospitalizations (Levitt et al., 1994), poor long-term outcome (Childers & Harding, 1990), poor adult social and vocational functioning (San et al., 2007), early and insidious onset of illness (Gupta et al., 1995; Vyas et al., 2007), poorer medication compliance (DeQuardo et al., 1994), and larger cerebral ventricles (Weinberger et al., 1980). Indeed, it has been suggested that poor premorbid adjustment may be indicative of a specific phenotype of increased genetic (Schmael et al., 2007) and/or environmental risk in schizophrenia.

1.3 Current Study

In this study, we examined PAS scores in a large sample of patients with schizophrenia, their unaffected siblings, and a control group free of any axis I disorders. We undertook this investigation to examine whether PAS ratings may also mark effects shared within a family (either genetic or shared environmental effects). While attempts to examine specific susceptibility genes or environmental risk factors for schizophrenia would be beyond the scope

of this paper, the aforementioned relationships between PAS scores and more pronounced clinical features of the illness suggest that the PAS is sensitive to and taps these risk factors. Furthermore, the good discriminative (Cannon-Spoor et al., 1982) and predictive validity (Brill et al., 2007) of the PAS in this context adds additional support to its utility in the measurement of adaptive functioning.

1.4 Hypotheses

Patients with schizophrenia share, on average, more heritable and environmental risk factors with their siblings than with non-related controls. Because these factors are present before the illness becomes evident, we hypothesized that patients would show worse PAS scores than siblings or controls. Furthermore, we hypothesized that siblings would show more abnormal scores than those of control participants. As previously mentioned, it is suggested that more abnormal premorbid adjustment ratings reflect increased genetic and/or environment risk Thus, we also hypothesized that siblings of patients with the most abnormal childhood and adolescent PAS scores would show the highest (most abnormal) PAS scores in the sibling group. To our knowledge, no study has investigated the PAS in such a large sample of patients, discordant siblings, and controls.

2. Method

Participants were 286 probands with schizophrenia (male: 216 (75.5%), female: 70, (24.5%), 315 of their healthy biological siblings (male: 129 (41%), female: 186, (59%) and 261 healthy control participants (male: 117 (44.8%), female: 144, (55.2%). Overall, 53.6% of the participants were male and 46.4% were female.[1] The sample was comprised of Caucasian, African-American, Hispanic, and Alaskan native or Native American individuals, as well as individuals who defined themselves as “mixed race” and individuals of Asian decent. Ages in the sample ranged from 16-64, but 95% of subjects were between the ages of 19 and 54. Demographic information parsed by diagnostic group is shown in Table 1. All individuals were recruited to participate in the Sibling Study in the Genes, Cognition, and Psychosis Program at the National Institute of Mental Health, a study of neurobiological phenotypes related to genetic risk for schizophrenia; details of recruitment for this study are described elsewhere (Egan et al., 2000). All participants gave written informed consent after receiving a full oral and written description of study procedures.

2.1 Diagnostic Status

In short, all probands fulfilled criteria for a DSM-IV diagnosis of schizophrenia or schizoaffective disorder in the absence of any other current axis I diagnosis. Diagnoses were made by either a clinical psychologist or psychiatrist using a revised version of the Standard Clinical Interview for DSM-IV (SCID). Siblings were all first degree full siblings of the probands included in the study. They were also free of any current axis I or II diagnosis and considered to be in full remission from any prior lifetime axis I or II diagnoses. We excluded any siblings who had a history of psychosis, even if it was in full remission at the time of the study. Healthy controls met the same criteria and had no family history of schizophrenia spectrum disorders. Additionally, all participants were free of any alcohol or drug abuse for at least six months before recruitment.

[1]Our sibling group is slightly larger than our patient group. This discrepancy exists because sibling data remained in our analyses even if it was not possible to collect PAS data from the related patient.

2.2 Data Collection

The original developer of the scale, Eleanor Spoor, completed all five subtests of the PAS with each subject, obtaining retrospective reports for all previous age periods. However, if a diagnosis of schizophrenia was met before adulthood, PAS subscales that covered the post-onset age periods were excluded; “premorbid” was defined as the period ending 6 months before evidence of psychosis (as evidenced by contact with a mental health professional, appearance of florid symptoms, etc.). Data for the General subscale was collected from all participants. The interviewer was theoretically blind to the diagnostic status of participants. However, due to frequently shared last names between patients and siblings, as well as issues with the scheduling of participants (family members were typically run through the protocol within days or weeks of each other), complete blindness to diagnostic status was not present in the current study.

2.3 Data Analysis

One of the three major assumptions of many parametric statistical tests (including Linear Regression and the ANOVA family) is independence of observations. However, because patients and siblings in this study are nested within family clusters, their PAS scores are theoretically intercorrelated and therefore not independent of each other. When using a regression framework, this within-cluster correlation typically leads to underestimated, or biased, standard errors and increased likelihood of Type I errors (particularly with small sample sizes). General Estimating Equations (GEEs) are increasingly becoming the standard for analyzing family data. They adjust the standard errors used in regression models to account for this within-cluster correlation of dependant variables, resulting in unbiased regression parameters. Further, they correct for the contribution of many data points by families with multiple patients and siblings, and allow for the inclusion of traditional covariates. GEE models are also robust to violations of normality and homogeneity of variance. Thus, we used GEE models with each of the PAS subtests, using an unstructured working correlation matrix. This allows for the actual and theoretical correlation (non-independence) of PAS scores within families. After finding significant differences between diagnostic groups in age, gender, and family SES, we included them as covariates in the models. Subsequently, we performed omnibus Wald Chi-Square analyses on the GEE adjusted marginal means to test whether there was a main effect of diagnostic group on PAS subtest scores. We also conducted pairwise comparisons on the resultant group means (analogous to those done in an ANCOVA) to investigate whether diagnostic groups differed from each other.

Visual inspection of these data suggested that proband PAS scores increased over time while scores in the other two groups did not. To investigate this observation, the adjusted marginal means and standard errors provided by each PAS subtest GEE analysis (see table 2) were used to conduct within-groups analytical comparisons (computed with the Welch's independent samples *t* statistic). Though these means are not technically independent, they benefited from the adjustments made by the generalized estimating equation models. Further, it was not possible to conduct dependant samples tests because the GEE analyses conducted did not provide adjusted scores at the individual participant level. Analogous contrasts were performed for the sibling and control groups for the purpose of comparison.

Next we sought to evaluate whether poor premorbid adjustment might run in families. To do this, we ran a separate hierarchical regression model for each PAS subtest. Because nesting within families was the focus, rather than a confounder, of this analysis, we elected to use the multiple regression model rather than the General Estimating Equation model. Nonetheless, we used a significance threshold of p=.01 to limit the possibility of type I errors.

In these regression models, we entered age, gender, and family SES in the first step to again eliminate variance in PAS scores attributable to these demographic factors. Next, we regressed PAS scores for the sibling group on their "family proband" scores; we sought to predict sibling PAS scores from their own ill siblings' scores. In the case of multiplex families, we averaged the scores for the multiple participants in the patient group.[2] Since the core construct the PAS was developed to assess is premorbid function, each analysis included only those dyads in which the proband(s) had not yet developed psychosis. Thus, for example, if a patient had become ill in late adolescence, data from that family was only included in the childhood and early adolescence analyses.

3. Results

As previously stated, there were significant differences in gender, family SES, age, and education between diagnostic groups. This was determined by conducting a one-way ANOVA with diagnostic status as the independent variable and age as the dependant variable ($F(2,857) = 5.417$, $p = .005$). A Levene's test for homogeneity of variance showed that gender had a heterogeneous distribution, so we performed a Kruskal-Wallis test and determined that diagnostic groups differed with respect to gender ($\chi^2 = 83.515$, $p<.0001$). We again posited that education and family SES values would be correlated within families. To investigate whether diagnostic groups differed with respect to these variables, we conducted another set of Generalized Estimating Equation analyses with diagnostic status as the independent variable and years of education, and family SES as the respective dependant variables. (Education: $\chi^2 = 233.122$, $p<.0001$; Family SES: Wald $\chi^2 = 13.722$, $p=.001$). Thus, we included gender, family SES, and age as covariates in our PAS analyses. We decided not to correct for education, because of the likely overlap in causes of poor premorbid function and educational attainment, as well as multi-collinearity between the education and Economic status variables; we thought correcting for education would obscure a real effect.

Estimated marginal means, adjusted in our GEE models for within family nesting and the three covariates, are plotted in figure 1. They are also reported in table 2, along with the raw, unadjusted PAS scores. Because of the large sample sizes, standard errors were small (reflected in the reported confidence intervals), as were the adjustments made to the raw PAS scores. There was a significant main effect of diagnostic status on PAS-Childhood (Wald $\chi^2 = 105.464$, $p<.0001$), PAS-Early Adolescence (Wald $\chi^2 = 178.177$, $p<.0001$), PAS-Late Adolescence (Wald $\chi^2 = 220.036$, $p<.0001$), PAS-Adulthood (Wald $\chi^2 = 253.593$, $p<.0001$), and PAS-General (Wald $\chi^2 = 648.495$, $p<.001$) scores. Results of post-hoc, between groups, pairwise comparisons are reported in table 3. In every instance, controls had significantly lower (i.e. more "normal") PAS scores than discordant siblings, who had significantly lower PAS scores than probands. All Bonferroni corrected p values were significant at the p<.0001 level, except for the control sibling comparison on the PAS-General scale, which was significant at the p<.001 level. Thus, patients performed more poorly than siblings who performed more poorly than controls at each PAS interval. It is worth noting that that the relatively poorer adjustment in siblings carried over into the Adult and General Ratings.

Effect sizes for the diagnostic group contrasts are also included in table 3. For each PAS subscale, effect sizes were largest for the control v. proband comparisons, followed by the sibling v. proband comparisons, then the control v. sibling comparisons. Furthermore, Cohen's d values for comparisons between the proband group and the other two groups increased as the PAS subscales moved chronologically from childhood through adulthood. Again, in each PAS subscale, the proband group only includes individuals not yet given a Schizophrenia

[2]In the current sample, there were 14 families in which there were two participants with schizophrenia.

diagnosis. Thus, as seen in Table 2, n's decrease slightly as the subscales move chronologically from childhood through adulthood.

Within-groups effects were also investigated to determine whether the PAS scores of participants in each diagnostic group changed over time. In the proband group, early adolescence scores did not differ from childhood scores [$t(515.784) = .000$, $p = 1.000$], but scores did increase significantly for all other epochs thereafter [late adolescence v. early adolescence: $t(458.782) = 3.38$, $p = .001$; adulthood v. late adolescence: $t(355.876) = 1.989$; $p = .048$], suggesting a decline in adjustment from early adolescence on. Scores for the control and sibling groups did not significantly increase over any developmental epochs. In siblings, PAS early adolescence scores did not differ from childhood scores [$t(611.692) = 1.410$; $p = .159$] and late adolescence scores did not differ from early adolescence scores [$t(611.692) = .000$; $p = 1.000$]. Similarly, control early adolescent scores did not differ from childhood scores [$t(451.247) = 1.387$; p = .165] and late adolescence scores did not differ from early adolescence scores [$t(506.160) = -.868$; $p = .385$]. However, PAS scores in the sibling group and control group decreased significantly from late adolescence to adulthood [siblings: $t(619.942) = -2.929$; $p = .004$; controls: $t(468.324) = -3.836$; $p = .000$], suggesting that individuals in these groups became better adjusted between adolescence and adulthood.

After controlling for age, gender, and family SES, proband PAS scores significantly predicted the PAS scores of their own siblings in the Childhood (*Beta* = .203, $p = .0004$, simple $R^2 = .041$) and Late Adolescence (*Beta* = .222, $p = .0003$, simple $R^2 = .049$) subscales. These results also approached significance in the Early Adolescence (*Beta* = .129, $p = .029$, simple $R^2 = .017$) and General (*Beta* = .128, $p = .029$, simple $R^2 = .016$) subscales. Results were not significant for the PAS Adulthood subscale (*Beta* = -.034, $p = .632$, simple $R^2 = .001$). We also computed simple correlations between patient scores and those of their own discordant siblings, after the same three covariates had been accounted for ($r = .205$, $r = .129$, $r = .223$, $r = -.034$, and $r = .128$ for the childhood through adulthood subscales, respectively). In the PAS General subscale, which again includes all patients and targets current general function, the patient/sibling correlation was $r = .128$. These data are summarized in table 4. Broadly, patient PAS scores appear to predict those of their siblings most strongly in the childhood and late adolescence subscales, uniquely accounting for roughly 4% and 5% of the variance. When including the covariates, the model accounts for roughly 6% and 7% of the variance in sibling childhood and late adolescence scores. Where the model only neared significance, patient scores uniquely accounted for 1.7% of the variability in sibling scores in the early adolescence subscale and 1.6% in the general subscale, while the whole model explained 2.8% and 3.7%, respectively.

4. Discussion

The goal of the current study was to investigate premorbid functioning, using the Premorbid Adjustment Scale, in a group of patients with Schizophrenia and their non-ill siblings. We are unaware of any previous study examining PAS or similar ratings in a large sample of non-twin siblings. Four main findings emerge from our analyses.

First, we found that schizophrenia patients in our large CBDB/NIMH cohort demonstrate robust evidence of impaired premorbid adjustment at all developmental epochs assessed, when compared with healthy control participants. Effect sizes for these differences were all large in size. This finding is consistent with a large body of prior literature.

Second, we found that unaffected siblings of patients showed higher PAS scores than controls, likely as a result of factors (genetic or environmental) shared with their ill family members.

These effects were in the small to medium range at all epochs, echoing findings from smaller family samples in prior literature.

Third, mean differences were larger between siblings and probands than between siblings and controls. While proband scores diverged from those of the other two groups between childhood and adulthood, differences stayed relatively constant between siblings and controls. More specifically, we found that proband adjustment scores progressively worsened from early adolescence into adulthood, while both sibling and control participants showed improved adjustment from late adolescence into adulthood, though maintained a statistically significant difference. These data suggest that patient functioning declines and diverges from that of the two unaffected groups as individuals get older. Findings also suggest that siblings maintain a relatively constant impairment in academic and social functioning throughout the lifespan, though do show normative improvements as they move from adolescence into adulthood.

It is worth noting that these findings differ from those recently reported by Walshe and colleagues (2007). These investigators examined ‘familial’ and ‘non-familial’ schizophrenia and showed PAS impairments in discordant siblings, but found that this difference only emerged in adolescence and was likely due to their poorer academic functioning relative to controls. It is very possible that had this benefited from larger sample sizes, they would have observed adjustment differences between the non-affected groups in childhood, as well.

A fourth finding of the present investigation further suggests that there may be a familial component to the aspects of development measured by the PAS. PAS scores in patients were significantly correlated with those of their siblings. Also, results of our regression models showed that patient PAS scores significantly predicted those of their own discordant siblings. Thus, patients with the highest PAS scores tended to have siblings with the highest PAS scores and vice, versa. This effect was significant in childhood and late adolescence, but only neared significance in early adolescence (thus, a relationship may exist there, as well, though further research is needed to substantiate this hypothesis). It was not significant in adulthood. The simple R^2's of these predictions were small, accounting for 4%, 1.7%, 4.9%, and .1%, of the variance in sibling PAS scores in the childhood through adulthood subscales, respectively.

The regression model also neared significance in the PAS General subscale (and had a simple R^2 of .016). However, this subscale is difficult to interpret in the present context; it compares the current general functioning of two groups originally selected to differ in this particular area. In the present study, all probands were selected because they met diagnostic criteria for schizophrenia—many of these criteria reflect aspects of social and academic/occupational functioning. Conversely, only siblings free of any current illness were selected for this analysis. Therefore, results for the PAS-General subscale are omitted from Table 4 are likely not useful in the within family analyses.

As a corollary to this finding, the predictive ability of patient scores did not maintain itself in adulthood. This lack of correlation in the adult years likely reflects two factors. First, the adult ratings of patients are possibly impacted by developmental and prodromal illness related factors that one would not expect to be shared with well siblings. Second, there is likely a “reciprocal feedback” effect such that poor social and academic function at earlier epochs affects the types of environments patients seek out, which in turn, lead to more abnormal PAS scores. For example, early social problems may lead to interpersonal difficulties and a tendency towards solitary activities that make the development of more advanced social skills difficult. For these reasons, it appears likely that the ratings from relatively early in childhood may offer the least confounded view on the neurodevelopmental features likely to be shared among siblings.

None of the above findings were accounted for by simple differences in socioeconomic circumstances, age, or gender. Combined, they suggest that there are familial components of

premorbid adjustment, as assessed by the Premorbid Adjustment Scale. They also suggest that aspects of childhood social and academic adjustment may be worthy of investigation as potential intermediate phenotypes in genetic studies.

Our results have a number of limitations, including the fact that retrospective interviews (using several items that could likely benefit from updating), were used to assess childhood events that occurred in the distant past, with recollection likely colored by subsequent personal and family experience. Second, the current study does not permit conclusions to be drawn about the relative contribution of genetic v. environment factors to the heritability observed in PAS scores. The current study also does not permit conclusions to be drawn about differences in social and academic adjustment, independently. Recent findings by Walshe et al. (2007) suggest that it might be beneficial to differentiate between these two constructs in future investigations of premorbid adjustment, as well as in future uses of the PAS.

Another limitation is that once patients met the threshold for psychosis, they were dropped from chronologically subsequent analyses, resulting in the use of slightly different samples in each subscale analysis. However, had they been included, these post-onset individuals would likely have shown the highest PAS scores. Thus, if anything, their exclusion likely adds a conservative bias to comparisons between probands and the other diagnostic groups. Another limitation emerges in the fact that the PAS rater was not completely blind to the diagnostic status of all participants. The fact that this imprecise tool was able to detect subtle abnormalities in well siblings suggests that more refined measurement approaches and prospectively acquired data might yield an even more robust signal.

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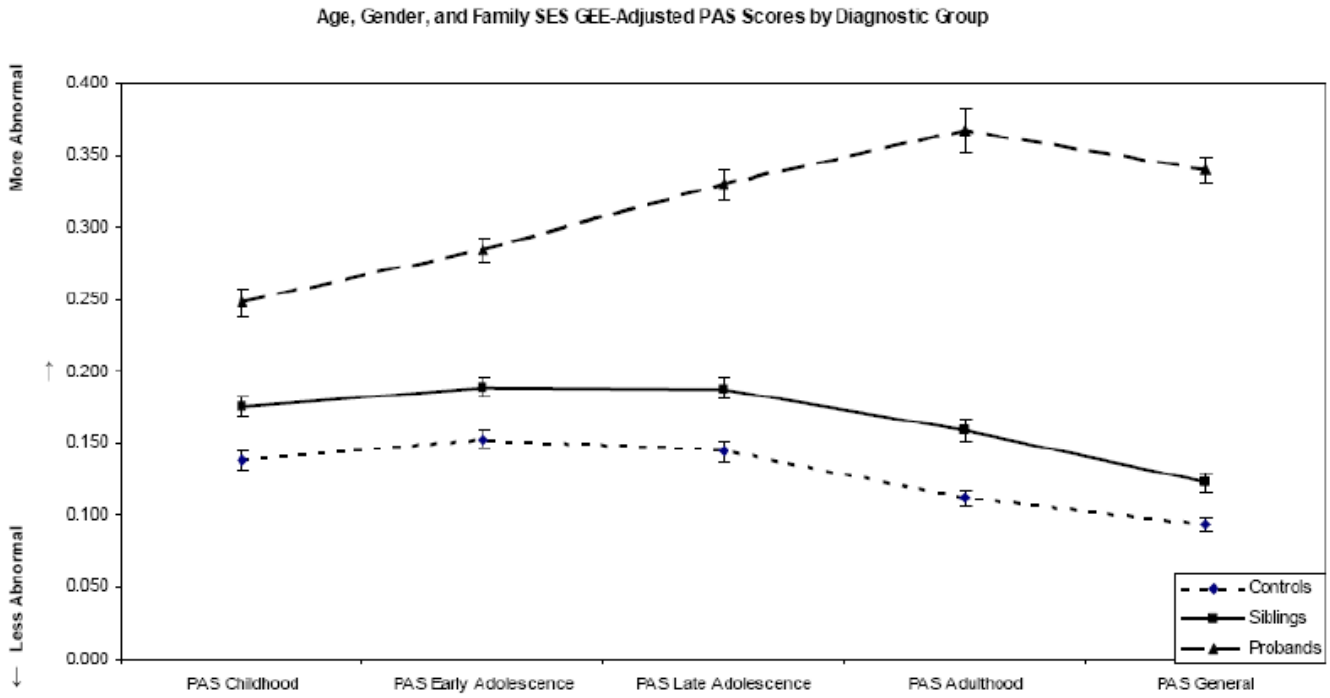

Figure 1.

Each line represents the GEE adjusted PAS subscores of controls, siblings, and patients with schizophrenia, respectively. In all cases, variance accounted for by age, gender, and family SES have been partialed out.

Table 1

Demographics of the current sample, parsed by diagnostic status.

Demographic Characteristics of Diagnostic Groups			
	Controls	Siblings	Probands
Age*	34.38 ± 10.05	36.94 ± 9.96	36.2 ± 9.44
Years of Education*	16.72 ± 2.85	15.87 ± 2.48	13.81 ± 2.14
Family SES[1]	48.1 ± 13.28	52.86 ± 12.77	51.79 ± 12.54
Gender			
Male	117 (44.8%)	129 (41%)	216 (75.5%)
Female	144 (55.2%)	186 (59%)	70 (24.5%)
Race/Ethnicity			
African American	34 (13%)	10 (3.2%)	13 (4.5%)
Hispanic	7 (2.7%)	6 (1.9%)	7 (2.4%)
Caucasian	204 (78.2%)	282 (89.5)	249 (87.1%)
Native American or Alaskan Native	1 (.4%)	2 (.6%)	2 (.7%)
Asian	8 (3.1%)	2 (.6%)	3 (1%)
Mixed Race	*7* (2.7%)	13 (4.1 %)	12 (4.2 %)

[1] Value plus or minus one standard deviation

Table 2

Each row shows the mean raw and GEE adjusted PAS scores for all three diagnostic groups. GEE models corrected for differences in age, family SES, and gender, as well as the intercorrelation of PAS scores within families. Adjustments to the raw values were small.

PAS Raw and GEE Adjusted Mean Scores

	Controls					Siblings					Probands				
			Adjusted					Adjusted					Adjusted		
	n	Raw	Mean[1]	SEM	95% CI	n	Raw	Mean[1]	SEM	95% CI	n	Raw	Mean[1]	SEM	95% CI
PAS childhood	260	.139	.138	.009	.126: .151	314	.175	.175	.007	.162: .190	286	.249	.284	.006	.231: .265
PAS early adolescence	260	.153	.153	.006	.142: .164	314	.188	.188	.006	.176: .201	277	.285	.284	.008	.268: .300
PAS late adolescence	260	.144	.145	.007	.131: .158	314	.187	.188	.007	.173: .202	246	.330	.330	.011	.309: .351
PAS adulthood	259	.113	.112	.005	.102: .123	308	.161	.159	.007	.145: .173	184	.368	.367	.015	.337: .397
PAS general	260	.094	.093	.005	.084: .103	314	.125	.123	.006	.111: .135	284	.340	.341	.005	.324: .358

[1] GEE Estimated Marginal Mean

Table 3

After adjustment in GEE analyses, all comparisons of PAS scores between diagnostic groups were significant. Effect sizes are also shown and were medium in magnitude during childhood, but large for all the other subscales

Planned Comparisons Between Diagnostic Groups; GEE Adjusted						
	Controls v. Siblings		Siblings v. Probands		Controls v. Probands	
	Mean Difference	Cohen's d	Mean Difference	Cohen's d	Mean Difference	Cohen's d
PAS- Childhood	0.037 [1]	0.333	0.073 [1]	0.535	0.110 [1]	0.864
PAS- Early Adolescence	0.035 [1]	0.342	0.096 [1]	0.77	0.132 [1]	1.129
PAS- Late Adolescence	0.043 [1]	0.353	0.142 [1]	0.944	0.185 [1]	1.295
PAS- Adulthood	0.047 [1]	0.426	0.208 [1]	1.211	0.255 [1]	1.612
PAS- General	0.030 [2]	0.303	0.218 [1]	1.664	0.247 [1]	2.094

[1] Bonferroni corrected, significant at $p < .0001$

[2] Bonferroni corrected, significant at $p < .001$

Table 4

Table shows the results of the within family regression analyses. Proband PAS scores in childhood and late adolescence significantly predicted those of their unaffected siblings. This effect approached significance in the Early Adolescence and General subscales. Effect sizes were small for these results.

Sibling Scores Predicted by their Related Probands[1]						
PAS Subscale	**n**	**Beta**	**p-value**	**R^2**	**Simple R^2**	**Simple Correlation**
Childhood	294	0.203	0.0004	0.059	0.041	0.205
Early Adolescence	288	0.129	0.029	0.028	0.017	0.129
Late Adolescence	257	0.222	0.0003	0.07	0.049	0.223
Adulthood	200	-0.034	0.632	0.02	0.001	-0.034
General	293	0.128	0.029	0.037	0.016	0.128

[1] Age, Gender, and Family SES controlled for