Schizophrenia spectrum personality disorders in psychometrically identified schizotypes at two-year follow-up

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A B S T R A C T

Earlier (Bolinskey et al., 2015), we reported that psychometrically identified schizotypes displayed greater symptom levels and higher incidences of schizophrenia spectrum (schizotypal, schizoid, paranoid, and avoidant) personality disorders (PDs). In this study, 49 schizotypes and 39 matched controls participated in follow-up assessments after two years. Participants were previously identified as schizotypes or controls based on scores on the Chapman Psychosis Proneness Scales (CPPS), and were interviewed at baseline and follow-up with the Personality Disorder Interview for DSM-IV (PDI-IV). At follow-up, schizotypes displayed significantly higher symptom levels compared to controls, with medium to large effects, and appeared to meet criteria for diagnosis of each PD more often than controls, although significant differences were only observed for paranoid PD. Overall, schizotypes were more likely to have met criteria for a diagnosis at either baseline or follow-up. Finally, we observed a widening disparity over time between schizotypes and controls in avoidant and schizoid PDs. These results suggest that schizophrenia spectrum PDs, as well as subthreshold symptoms of these disorders, can represent a greater liability for schizophrenia in individuals identified as at-risk on the basis of psychometric means only. Furthermore, these findings demonstrate that such differences persist, and in some cases increase, over time.

1. Introduction

Previously (Bolinskey et al., 2015), we reported significantly greater numbers of symptoms of paranoid, schizoid, schizotypal, and avoidant personality disorders (PDs), as well as a significantly higher incidence rate of meeting diagnostic criteria for each of the disorders at baseline among psychometrically identified schizotypic individuals in comparison to a matched comparison sample. These results were important in advancing the idea that normally functioning individuals with liability for schizophrenia as defined by psychometric schizotypy display subthreshold symptoms of schizophrenia spectrum PDs. We also added to the evidence base for inclusion of avoidant PD as a schizophrenia spectrum PD by demonstrating stronger display of its symptoms in our psychosis-prone group than in our controls. With this follow-up report, we aimed to find additional support for schizophrenia spectrum PDs in individuals at risk for developing schizophrenia by examining these traits in both samples at two-year follow up. Beyond this, we hoped to observe a widening disparity between schizotypes and matched controls, thereby extending our previous findings to demonstrate that schizophrenia onset occurs in a developmental process that involves at-risk individuals displaying increasing psychopathology on a specific trajectory that can be documented over time.

1.1. Background

The development of schizophrenia is associated with increased
signs of certain PDs in those thought to possess increased liability for the disorder. Historical study of schizophrenia spectrum disorders (SSDS) has revealed that the genetic underpinnings of the illness display themselves in those who are at risk for, but do not necessarily develop, schizophrenia, and that these displays overlap with pathological personality traits. One such avenue of discovery was the observation of individuals with schizophrenia and their relatives, who often display attenuated signs of the disorder, including odd or eccentric personality and withdrawal from others (Bleuler, 1950; Gottesman, 1991; Kraepelin, 1909/1971). More recent family studies confirm the association between schizophrenia and PDs, including schizotypal PD, in families (Kendler et al., 1993) and that higher degrees of genetic relatedness to relatives with schizophrenia are associated with higher rates of schizotypal symptoms (Torgersen, 1985). Additionally, siblings of individuals with schizophrenia exhibit symptoms of Cluster A PDs at a greater rate compared to healthy controls (Torti et al., 2013).

The Cluster A PDs have also been found to be present in the prodromal phase of schizophrenia (Solano and De Chávez, 2000). Conceptually, the Cluster A disorders represent the intermediate of a continuum of schizophrenic pathology, composed of mild traits on one extreme and frank psychosis on the other. Schizophrenia appears to fall along the same etiological spectrum as paranoid, schizoid, and schizotypal PDs, with the shared neurodevelopmental aberrations that result in either disorders of premorbid adjustment or as Cluster A PDs. Meehl (1990) also posited that premorbid Cluster A PDs may be associated with a greater genetic diathesis for schizophrenia and consequentially, a poorer prognosis and course. Increasingly, avoidant PD is also recognized as a possible indicator of risk, with comparable premorbid rates of this disorder to those of Cluster A PDs in individuals with schizophrenia (Solano and De Chávez, 2000). Avoidant PD symptoms also occur in relatives of individuals with schizophrenia at higher rates than in controls, even when controlling for the presence of paranoid and schizotypal PDs (Fogelson et al., 2007), and these symptoms are related to poorer neurocognitive performance in relatives (Fogelson et al., 2010).

The association between these PDs and schizophrenia might represent evidence for the idea of schizophrenia as a developmental process. As such, premorbid personality characteristics might represent endophenotypes of schizophrenia, in that they signal the underlying genetic vulnerability prior to the onset of illness, are stable and lying genetic vulnerability prior to the onset of illness, are stable and

1.3. Identifying liability to schizophrenia

In research on liability to SSDS, researchers have employed various definitions of schizotypy, including genetic relatedness in family studies (Gottesman, 1991), clinically observable signs and symptoms associated with premorbid schizophrenia (Correll et al., 2010), and PDs that are demonstrably predictive of SSDS (Bolinskey and Gottesman, 2010). Extensive research has also been employed toward validating self-report questionnaires that can identify schizotypy in the general population. These include the Schizotypal Personality Questionnaire (SPQ; Raine, 1991) and the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason et al., 1995). The Chapman Psychosis Proneness Scales (CPPS) have gained considerable support in the literature for their validity in predicting mental health outcomes, and thus have been widely used as the benchmarks for identifying schizotypy in studies examining putative endophenotypes of schizophrenia.

The CPPS were developed based on Meehl’s, (1962, 1990) conceptualization of schizotypy, and to reflect the heterogeneity in SSDS (Chapman et al., 1980). Rather than providing a unidimensional estimation of one’s liability to SSDS, the CPPS include separate scales that measure specific domains within a constellation of signs and symptoms that indicate liability to psychosis. These scales are: the Perceptual Aberration Scale (PerAb; Chapman et al., 1978), a measure of sensory and body-image distortions, the Magical Ideation Scale (MagI; Ekblad and Chapman, 1983), which measures delusional or odd beliefs, and the Revised Physical Anhedonia Scale (PhysAnh; Chapman et al., 1976), which captures lack of physical or sensory pleasure. Additionally, the Revised Social Anhedonia Scale (SocAnh; Ekblad et al., 1982) measures inability to find pleasure in social relationships.

The CPPS is one of the most widely used assessment tools in research examining liability to schizophrenia-spectrum illness.
SocAnh in college students have been found to correlate with clinical high-risk symptoms as assessed by interview (Cicero et al., 2014). Further evidence for the ability of the CPPS to distinguish those with psychosis risk exists. Offspring of parents with schizophrenia scored significantly higher on the CPPS compared to controls, and the presence of an externalizing disorder in offspring predicted the highest CPPS scores of the group (Keshavan et al., 2008). Moreover, individuals psychometrically classified as schizotypal exhibit greater elevations on MMPI scales predictive of schizotypal and paranoid PDs (Lenzenweger and Korfine, 1992). Scores on PerAb, MagId, and SocAnh in college students have been found to correlate with clinical high-risk symptoms as assessed by interview (Ciervo et al., 2014).

Research documenting cognitive and perceptual factors increasingly reveal a schizotypic phenomenology that mirrors which that occurs in schizophrenia (Etinger et al., 2015). One recent developmental model characterizes schizotypy as a stable trait that serves as a mediating liability factor between early risk factors as captured by endophenotypes and high-risk clinical prodromal states that ultimately result in psychosis (Debannée and Barrantes-Vidal, 2014).

1.4. Present study

We previously reported findings from the first phase of our study, in which schizotypal and normal groups were drawn from a college-based sample, and incidence of PD symptom endorsement and rate of meeting diagnostic criteria for paranoid, schizoid, schizotypal, and avoidant PDs were assessed at baseline (Bolinskey et al., 2015). In the current study, we assess symptom endorsement and incidence of meeting diagnostic criteria in each group at two-year follow up. The study was multifaceted in its goals. We intended to examine the viability of premorbid personality characteristics as endophenotypes for schizophrenia. As psychometrically identified schizotypal are assumed to possess underlying genetic liability for schizophrenia, an increasing display of psychopathology will confirm that the presence of personality traits prior to the onset of such pathology represent early markers of a genetic diathesis. This study also aimed to test the assertion that schizophrenia occurs as a developmental process. If this assertion holds true, then there will be a widening disparity between schizotypic and normal groups in terms of PD symptoms and diagnoses.

Finally, we sought to examine the validity of the CPPS in terms of its ability to predict later mental health outcomes. The CPPS is widely used as a benchmark for evaluation other putative indicators of schizophrenia risk. Thus, the utility of the evidence drawn from such studies rests on the reliability of the CPPS as a useful measure of schizotypy.

Considering these goals, we made the following hypotheses:

1) Psychometrically identified schizotypal would endorse more symptoms of these PDs than matched controls at two-year follow-up.
2) Similarly, schizotypes were expected to meet criteria for paranoid, schizoid, schizotypal and avoidant PDs at a higher rate compared to matched controls at two-year follow-up.
3) Schizotypes were expected to meet diagnostic criteria for paranoid, schizoid, schizotypal and avoidant PDs at a higher rate compared to matched controls at either baseline or follow-up (i.e., a “lifetime” diagnosis).
4) Finally, we expected to observe a widening disparity in the rate of meeting diagnostic criteria for the selected PDs from initial assessment to follow-up.

2. Methods

2.1. Participants

Our participant pool consisted of 85 individuals (11 males, 74 females) previously identified as schizotypal (SZT group) on the basis of their CPPS scores and 78 individuals (11 males, 67 females) in a matched comparison (MC) group (N.B., data was not available for 7 MC participants). Participants were screened for valid responses with the CPPS infrequency scales as well as validity measures of the MMPI-2 and the PDQ-4. Ascertaining of the groups was fully described in Bolinskey et al. (2015). Briefly, the criterion for inclusion in the SZT group was a score of more than 1.96 standard deviations above the gender-based mean on any of the CPPS scales of interest in the current study. In order to control for the possible effect of demographic variables on the variables of interest, the MC group was selected whose demographics aligned as closely as possible with the SZT group. Thus, for each SZT participant, an MC participant was matched on (in order) gender, ethnicity, age, and college major. When a match was not possible on one of these criteria, the match was made with the participant closest to the SZT participant on that particular criterion.

There were no significant differences in age by group, gender, or the interaction of group by gender. At two-year follow-up, we were able to reassess 49 of 85 SZT participants (8 males, 41 females) and 39 of 78 MC participants (6 males, 33 females). There was no significant difference in age between the SZT (M=20.9, SD=0.82) and MC (M=20.7, SD=0.85) groups.

2.2. Procedures

At baseline, participants had completed assessment with the Personality Disorder Interview for DSM-IV (PDI-IV; Widiger et al., 1995), a semi-structured interview to assess PDs. At that time, each participant was asked to provide permanent contact information for themselves, as well as for someone who would know their whereabouts in five years. Two years after the date of their baseline administration, attempts were initiated to contact each participant using a variety of means, such as e-mail and phone calls. Participants who agreed to participate were scheduled for a follow-up interview.

Each interview was conducted by one of 11 master’s-level clinicians who had been trained in the administration and scoring of the interview and who were blind to group membership. In addition, the scoring of each protocol was verified by one of the other administrators; in cases of discrepancy in the scoring of an item, the raters discussed the discrepancy and a consensus was reached for that item’s scoring. A participant was judged to have met criteria for a particular PD if their score reached the “threshold,” “moderate,” or “extreme” levels for that disorder, as directed in the PDI-IV manual.

Symptom levels by group were compared using a multivariate analysis of variance (MANOVA), with group membership as the independent variable, and paranoid, schizoid schizotypal, and avoidant symptom scores serving as the dependent variables. Univariate analyses of variance (ANOVA) were then utilized to compare differences on individual dependent variables and effect sizes were computed.

We also compared the distributions of meeting diagnostic criteria for each PD by group membership. Since three of the four comparisons (paranoid, schizoid, and schizotypal PDs) had at least one cell with an expected N of less than five, chi square tests were not appropriate. Fisher’s exact test is commonly used in such situations, although there have been suggestions that it is overly conservative with small samples (Martin Andrés et al., 2004); thus, we chose to employ Barnard’s exact test along with Fisher’s exact test to compare distribution differences. In addition to tests of significance, odds ratios were calculated for each comparison, when possible.

To compare changes in the distributions for meeting diagnostic criteria within each group, McNemar’s tests were employed. In order to
do this, each group was examined independently. A significant change in the distribution in the SZT group along with the lack of significant change in the MC group would be considered as support for the hypothesis.

3. Results

3.1. Comparison of baseline symptoms between follow-ups and non-follow-ups

Analyses of variance revealed no baseline differences in PD symptoms between those participants who participated in two-year follow-up assessments and those who did not. Neither were there any significant differences for the interaction of group membership and follow-up status. When we examined baseline scores within each group separately, however, we found that those in the SZT group who participated in two-year follow-up assessments evidenced slightly more avoidant PD symptoms ($M=3.5$, $SD=2.3$) than those who did not ($M=2.4$, $SD=2.3$; $F=4.83$, $d=0.48$). There were no differences in baseline scores within the SZT group for the other three disorders, nor among any of the disorder within the controls who participated in two-year follow-up assessments and those who did not.

3.2. PD symptoms at follow-up

Correlations among the symptom levels for each PD at baseline and two-year follow-up are shown in Table 1. Symptom levels of each disorder at baseline were significantly correlated with symptom levels of other disorders, but for each disorder the highest correlations were observed for the same disorder at follow-up.

The results of the multivariate test revealed a significant difference between groups, $F(4, 83)=3.56$, $p<0.010$. Wilks’ lambda for the analysis was 0.85, which suggests that approximately 15% of the variance in the linear combination of symptom levels can be accounted for by group membership.

Since the multivariate test was significant, univariate tests were performed for mean symptom level by group. Mean symptom levels for each group are displayed in Table 2, along with appropriate effect sizes. The results of each comparison were significant at $p<0.05$. Medium effect sizes were observed for avoidant ($d=0.46$), paranoid ($d=0.57$), and schizoid ($d=0.48$) PD symptoms, whereas a large effect was observed for schizotypal PD symptoms ($d=0.70$).

3.3. Meeting criteria for PDs at follow-up

We then examined whether there were differences in the number of individuals meeting diagnostic criteria at two-year follow-up between the SZT and MC groups, as determined by the PDI-IV. Results of Barnard’s and Fisher’s exact tests are displayed in Table 3. Both Barnard’s and Fisher’s exact tests were significant only for paranoid PD.

The odds ratios indicate that individuals in the SZT group were 6.33 times more likely to meet criteria for schizoid PD than were the individuals in the MC group (95% CI =0.75 to 53.87) and 2.25 times more likely to meet criteria for avoidant PD (95% CI =0.85 to 5.94), although the confidence intervals around both of these estimates include 1. Odds ratios could not be calculated for paranoid and schizotypal personality disorder, as none of the MC participants met diagnostic criteria.

Next, we examined whether there were differences between the SZT and MC groups in the number of individuals meeting diagnostic criteria at any point (i.e., baseline or two-year follow-up). This analysis allowed us to count as “hits” individuals who met diagnostic criteria at baseline, but who did not participate in follow-up assessments. Results of Barnard’s and Fisher’s exact tests are displayed in Table 4, along with baseline results for comparison. With the additional statistical power gained by the larger sample size, both Barnard’s and Fisher’s exact tests were significant for each PD.

The odds ratios indicate that individuals in the SZT group were 15.18 times more likely to meet criteria for schizoid PD than were the individuals in the MC group (95% CI=1.95 to 118.44). They were 6.86 times more likely to meet criteria for schizotypal PD (95% CI=1.50 to

### Table 2

Means and standard deviations for selected Personality Disorder Interview for DSM-IV scores at two-year follow-up by group membership, with associated F values and effect sizes.

<table>
<thead>
<tr>
<th>Scale</th>
<th>SZT ($N=49$) M (SD)</th>
<th>MC ($N=39$) M (SD)</th>
<th>$F$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Avoidant PD sx</td>
<td>2.61 (2.21)</td>
<td>1.67 (1.78)</td>
<td>4.69 $^*$</td>
<td>0.46</td>
</tr>
<tr>
<td>Level of Paranoid PD sx</td>
<td>1.22 (1.57)</td>
<td>0.48 (0.82)</td>
<td>7.04 $^*$</td>
<td>0.57</td>
</tr>
<tr>
<td>Level of Schizoid PD sx</td>
<td>1.51 (1.49)</td>
<td>0.84 (1.20)</td>
<td>5.10 $^*$</td>
<td>0.48</td>
</tr>
<tr>
<td>Level of Schizotypal PD sx</td>
<td>2.01 (1.73)</td>
<td>1.00 (1.00)</td>
<td>10.75 $^*$</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Note: SZT = psychometrically-identified schizotype group; MC = matched comparison group; $d =$ Cohen’s $d$.

### Table 3

Number of individuals meeting or not meeting criteria for selected personality disorders by group, along with results of exact tests and odds ratio estimates.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Group</th>
<th>Yes</th>
<th>No</th>
<th>Barnard’s Test</th>
<th>Fisher’s Test</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidant</td>
<td>SZT</td>
<td>18</td>
<td>31</td>
<td>$p=0.105$</td>
<td>$p=0.107$</td>
<td>2.25 (0.85–5.94)</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>8</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paranoid</td>
<td>SZT</td>
<td>6</td>
<td>43</td>
<td>$p=0.033$</td>
<td>$p=0.032$ *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>0</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizoid</td>
<td>SZT</td>
<td>7</td>
<td>42</td>
<td>$p=0.078$</td>
<td>$p=0.072$</td>
<td>6.33 (0.75–53.87)</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>1</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schizotypal</td>
<td>SZT</td>
<td>4</td>
<td>45</td>
<td>$p=0.127$</td>
<td>$p=0.126$ *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>0</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: SZT = psychometrically identified schizotypes. MC = matched control. ‘*’ Odds ratios could not be calculated for paranoid and schizotypal personality disorder, as none of the MC participants met diagnostic criteria.

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**Note:**

* $p < 0.001$.

$^*$ $p < 0.05$. 

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**Table 1**

Correlations among number of symptoms of schizophrenia-related personality disorders at baseline and at 2-year follow-up.

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Avoidant, 2 years</th>
<th>Paranoid, 2 years</th>
<th>Schizoid, 2 years</th>
<th>Schizotypal, 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidant, baseline</td>
<td>0.61 $^*$</td>
<td>0.19</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Paranoid, baseline</td>
<td>0.31 $^*$</td>
<td>0.50 $^*$</td>
<td>0.21 $^*$</td>
<td>0.19</td>
</tr>
<tr>
<td>Schizoid, baseline</td>
<td>0.14</td>
<td>0.25</td>
<td>0.43 $^*$</td>
<td>0.34 $^*$</td>
</tr>
<tr>
<td>Schizotypal, baseline</td>
<td>0.24 $^*$</td>
<td>0.42 $^*$</td>
<td>0.11</td>
<td>0.40 $^*$</td>
</tr>
</tbody>
</table>

Note:

* $p < 0.001$.

$^*$ $p < 0.05$. 

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**Table 4**

Means and standard deviations for selected Personality Disorder Interview for DSM-IV scores at baseline by group membership, with associated F values and effect sizes.

<table>
<thead>
<tr>
<th>Scale</th>
<th>SZT ($N=49$) M (SD)</th>
<th>MC ($N=39$) M (SD)</th>
<th>$F$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Avoidant PD sx</td>
<td>2.61 (2.21)</td>
<td>1.67 (1.78)</td>
<td>4.69 $^*$</td>
<td>0.46</td>
</tr>
<tr>
<td>Level of Paranoid PD sx</td>
<td>1.22 (1.57)</td>
<td>0.48 (0.82)</td>
<td>7.04 $^*$</td>
<td>0.57</td>
</tr>
<tr>
<td>Level of Schizoid PD sx</td>
<td>1.51 (1.49)</td>
<td>0.84 (1.20)</td>
<td>5.10 $^*$</td>
<td>0.48</td>
</tr>
<tr>
<td>Level of Schizotypal PD sx</td>
<td>2.01 (1.73)</td>
<td>1.00 (1.00)</td>
<td>10.75 $^*$</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Note: SZT = psychometrically-identified schizotype group; MC = matched comparison group; $d =$ Cohen’s $d$.
Table 4
Number of individuals meeting, or not meeting, criteria for baseline and lifetime diagnosis of selected personality disorders by group, along with results of exact tests and odds ratio estimates.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Group</th>
<th>Baseline Criteria Met</th>
<th>Lifetime Criteria Met</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Avoidant</td>
<td>SZT</td>
<td>36</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>49</td>
<td>63</td>
</tr>
<tr>
<td>Paranoid</td>
<td>SZT</td>
<td>11</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Schizoid</td>
<td>SZT</td>
<td>8</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>0</td>
<td>78</td>
</tr>
<tr>
<td>Schizotypal</td>
<td>SZT</td>
<td>11</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>2</td>
<td>76</td>
</tr>
</tbody>
</table>


3.5. Change in distribution meeting diagnostic criteria for PDs from baseline to 2 years

Finally, we examined whether there were significant changes in the number of individuals meeting diagnostic criteria within each group. Results are displayed in Table 5.

There were no significant changes among the MC group, although avoidant PD approached significance due to the additional five individuals in the MC group who met criteria at follow-up. Within the SZT group, significant changes were observed for avoidant and schizoid PDs.

4. Discussion

Overall, the results of our analyses provide additional support for the concept of schizotypy, as well as the ability of the CPPS to identify individuals with schizotypy. In terms of our hypotheses, two were fully supported and two were partially supported.

Our first hypothesis – that individuals identified as schizotypic would endorse more symptoms of schizophrenia-related PDs at two-year follow-up – was fully supported. Not only did our SZT group meet significantly more criteria for each of the four PDs of interest than did MC group, but the effects for each of these differences ranged from medium to large. This finding is important as it demonstrates that subthreshold expression of symptoms of schizotypy can be identified in individuals who are otherwise relatively high functioning and that these symptom differences persist across time even in the absence of identifiable PDs.

Our second hypothesis – that the SZT group would be more likely to meet diagnostic criteria for each of these disorders – was only partially supported. As in our previous study (Bolinskey et al., 2015) this hypothesis was considered secondary because we did not expect that the majority of the individuals in the SZT group would meet full criteria for a spectrum disorder at this stage of the study, but we would expect a higher incidence among the SZT participants. We only observed a significant difference in prevalence at follow-up for paranoid PD. However, our relatively small sample size likely impacted the observed significance levels. It is noted that the differences in the incidence of schizoid PD approached statistical significance. For all disorders, the trend appeared to be toward higher incidence rate among the SZT participants.

Our third hypothesis was that SZT participants would be more likely to have met diagnostic criteria for paranoid, schizoid, schizotypal, and avoidant PDs at either baseline or follow-up than MC participants; for these analyses, we carried forward baseline diagnoses for those individuals from whom we were unable to obtain follow-up data. This hypothesis was fully supported as the SZT participants were more likely to meet diagnostic criteria at some point in the study for each of the four PDs.

Our fourth hypothesis – that we would observe a widening disparity between the SZT and MC groups over time in the lifetime diagnostic rates for each of these disorders – was partially supported. We observed significant increases in the presence of both avoidant and schizoid PDs within the SZT group with no corresponding significant differences in the MC group, although the increase for avoidant PD in the MC certainly approached significance. The increases in paranoid and schizotypal PDs were not significant in the SZT group, although we note the presence of two new cases of each disorder in the SZT group and no new cases in the MC group.

Taken together, our results provide continued support for the identification of schizotypy through psychometric means, rather than relying on family history or diagnostic interviews (e.g., Kendler et al., 1993; Asarnow et al., 2001; Hans et al., 2004). The results of our study indicate that not only do individuals identified as schizotypic have identifiable personality differences at the time of identification, but also
that these differences persist – and, in some cases, increase – over time. This data also supports the inclusion of avoidant PD as a schizophrenia spectrum PD.

These results replicate previous findings that the CPPS may be used to predict schizophrenia spectrum disorders, including schizophrenia spectrum PDs, in non-clinical samples (Kwapil, 1998; Gooding, 2005), although these studies reported on findings collected after five and ten years, respectively. At 25-month follow-up, the *PerMag* group in an initial study of the CPPS reported adjustment and emotional problems, utilization of mental health services, and psychotic-like symptoms at greater rates compared to controls (Chapman and Chapman, 1985). Here, we report on results obtained after a similar follow-up interval, but add that personality characteristics, specifically, may be predicted over this length of time. Other studies (Gooding et al., 2005, 2007) have not offered information about symptomatology level—only rates of PD diagnoses assigned. Our hope in documenting PD symptom level is to observe the development of psychopathology at a more subtle level and with more precision than would be allowed by observations of diagnosis incidence only. Indeed, we observed stable differences between our groups by analyzing symptom levels of these disorders. We expect to observe stronger disparities between our groups in diagnosis after longer follow-up intervals, similar to what has been reported in other studies (Chapman et al., 1994; Gooding et al., 2005).

Additionally, we collected data on the PD variables at initial testing (Bolinskey et al., 2015), which has not taken place in other studies (e.g., Gooding et al., 2005) despite the utility of this practice in making comparisons across time. Cultivating a greater understanding of the developmental course of SSDs will aid in early detection efforts through illuminating both the early signs of these disorders in those who eventually manifest them, as well as identifying factors protective against conversion to SSDs in those who do not.

One weakness of the current study is the large number of participants who were not available for follow-up evaluation. This impacted each of our analyses, albeit in different manners. We assessed lifetime diagnosis of PDs and carried forward the diagnoses of participants who were unavailable in addressing the problem of missing follow-up data. It is possible that some SZT participants who did not initially meet criteria for a PD, might have met criteria at follow-up had we been able to contact them. This would have raised the number of SZT with a lifetime PD diagnosis and strengthened our results; note that no change in diagnostic status among the SZT members we could not contact had no effect on the outcome of the present study. In other words, our results might have been more robust had we been able to contact greater numbers of SZT participants for follow-up. Conversely, some of the MC participants whom we were unable to reach might have met criteria for a PD at follow-up, thereby weakening our findings regarding lifetime diagnoses in this group; in this case, the lack of follow-up and the consequent carrying-forward of a non-diagnosis would actually strengthen our results. The lack of males in the current sample represents another limitation of our study, especially in light of the fact that males tend to develop psychosis earlier than females.

In our initial report (Bolinskey et al., 2015), we demonstrated a greater occurrence of PDs and PD symptoms in psychometrically identified schizotypes relative to controls. Based on our two-year follow up data, we conclude that symptoms of paranoid, schizoid, schizotypal, and avoidant PDs found among individuals determined to be at increased risk for developing schizophrenia persist across time. We also obtained preliminary evidence in support of a longitudinal pattern in which schizotypes display increasing levels of schizophrenia spectrum PD symptoms and meet criteria for these PDs at greater rates. We are now engaged in collecting six-year follow up data that we expect will continue to document differences in personality between schizotypes and controls over time. We plan to redouble our efforts to make contact with the individuals for whom no two-year follow-up data was available.

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**References**


