Cannabis and psychometrically-defined schizotypy: Use, problems and treatment considerations

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Abstract

Cannabis use is associated with onset of psychosis in individuals vulnerable for developing schizophrenia-spectrum disorders. The present study addressed three knowledge gaps pertaining to this issue: 1) clarifying the incidence of cannabis use in schizotypal individuals, 2) examining how cannabis use is related to psychosocial and physiological problems in schizotypy and interest in treatment, and 3) examining how cannabis use is associated with positive, negative and disorganization features of schizotypy. Scores from a measure of schizotypal traits were used to trichotomize 1665 young adults into schizotypy (top 5% of scorers), non-schizotypy (bottom 50% of scorers) and approximately 10%. Thus, only a small minority of subjects in prior research would be considered schizotypal in any meaningful sense of the word. Rather, it may be that individuals who endorse greater cannabis use show eccentric or otherwise unconventional (but not necessarily schizotypal) beliefs. These beliefs could be related to the acute effects of cannabis which are similar in some respects to the perceptual distortions, ideas of reference, anxiety, suspiciousness and odd behavior traits associated with schizotypy (Barkus and Lewis, 2008). The link between cannabis use and unconventional beliefs could also reflect that individuals electing to use cannabis tend to be unconventional or eccentric in behavior and beliefs compared to their peers (Earleywine, 2006; Morrison et al., 2009). With respect to understanding the link between schizotypy and cannabis use however, the established literature is limited because it

1. Introduction

It is well-accepted that cannabis use is associated with onset of psychosis in individuals vulnerable for developing schizophrenia-spectrum disorder (Arseneault et al., 2004; Caspi et al., 2005; Hall et al., 2004). A critical issue in this regard involves understanding how cannabis use behaviors manifest in schizotypy—defined in terms of a putatively genetic vulnerability for schizophrenia-spectrum pathology (Meehl, 1962). The present study examined three knowledge gaps pertaining to this issue. We aimed to: 1) clarify the incidence of cannabis use in schizotypal individuals, 2) examine how cannabis use is related to psychosocial and physiological problems in schizotypy and examine interest in treatment for cannabis use and for treatment more generally, and 3) examine how cannabis use is associated with positive, negative and disorganization features of schizotypy. These gaps are discussed below.

Regarding the first knowledge gap, there is some support for the notion that greater cannabis use is associated with schizotypal traits. Numerous studies have found psychometrically-defined schizotypy (defined dimensionally in nearly every study) to be significantly associated with greater cannabis use (Bailey and Swallow, 2004; Dumas et al., 2002; Earleywine, 2006; Esterberg et al., 2009; Mass et al., 2001; Schiffman et al., 2005; Skosnik et al., 2001, 2006; see also Arendt et al., 2008; Caspi et al., 2005; Compton et al., 2009; Miller et al., 2001 for family/genetic studies). Notably, however, theory (Meehl, 1962) and research (e.g., note over a dozen taxometric studies to date; e.g., Lenzenweger and Korfine, 1992) suggest that schizotypy is categorical in nature with a population incidence of approximately 10%. Thus, only a small minority of subjects in prior research would be considered schizotypal in any meaningful sense of the word. Rather, it may be that individuals who endorse greater cannabis use show eccentric or otherwise unconventional (but not necessarily schizotypal) beliefs. These beliefs could be related to the acute effects of cannabis which are similar in some respects to the perceptual distortions, ideas of reference, anxiety, suspiciousness and odd behavior traits associated with schizotypy (Barkus and Lewis, 2008). The link between cannabis use and unconventional beliefs could also reflect that individuals electing to use cannabis tend to be unconventional or eccentric in behavior and beliefs compared to their peers (Earleywine, 2006; Morrison et al., 2009). With respect to understanding the link between schizotypy and cannabis use however, the established literature is limited because it

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does not differentiate clinically-meaningful schizotypy from sub-threshold unconventional beliefs.

A second knowledge gap concerns the degree to which cannabis use is problematic for individuals with schizotypy, and the degree to which these problems affect interest in treatment. In the larger population cannabis use is associated with a host of psychological, neurocognitive and functional maladies (Agosti et al., 2002; Hayatbakhsh et al., 2007; Reilly et al., 1998; Thomas, 1996). Despite this, treatment interest is generally low (Buckner et al., 2010; Cunningham, 2005). In patients with schizophrenia, cannabis use is associated with a range of maladies, including increased hospitalizations, the need for increased antipsychotic dosages, exacerbation of positive and disorganization symptoms, and increased cognitive problems (Caspari, 1999; D’Souza et al., 2005; Dixon, 1999; Negrete et al., 1986). Moreover, cannabis use is a negative prognostic indicator for treatment for patients with schizophrenia (Dixon, 1999). The question of whether cannabis use is associated with functional impairment and treatment in schizotypy has received minimal attention. One would expect that individuals with schizotypy would experience greater cannabis-related problems compared to the general population, as schizotypal individuals already experience a range of neurocognitive, psychosocial and psychiatric concerns (e.g., Cohen et al., 2006) that would presumably be exacerbated with cannabis use. The present study also examined the degree to which individuals with schizotypy are interested in treatment for cannabis use or other psychiatric concerns, and how treatment interest is affected as a function of cannabis use.

A third knowledge gap concerns schizotypy heterogeneity. Similar to schizophrenia, schizotypy is a dramatically heterogeneous phenomenon and there are no known biological, neurocognitive, symptom or behavioral markers present in all cases. Thus, an important question concerns elucidating which traits of schizotypy are most strongly related to cannabis use, and conversely, which schizotypal aspects are inversely related to cannabis use. In patients with schizophrenia, cannabis use appears related to more severe positive and less severe negative symptoms (Compton et al., 2007; D’Souza et al., 2005; Potvin et al., 2006). These findings have generated interesting theories that cannabis use relieves negative symptom severity (Potvin et al., 2006) and alleviates negative affect (Green et al., 2004) and that cannabinoid receptors play a role in positive symptoms (D’Souza et al., 2005). In schizotypy, greater cannabis use has been correlated to less negative and greater severity of positive and disorganization traits (Esterberg et al., 2009; Nunn et al., 2001; Schifman et al., 2005). As noted above however, these findings are difficult to interpret because schizotypy was defined dimensionally such that few of the subjects had clinically-meaningful schizotypal.

The present study examined these three knowledge gaps in a large non-psychiatric young adult population. Young adults were examined because this age range is particularly vulnerable to cannabis use and use-related problems (Administration, 2006; Johnston et al., 2007). The sample was trichotomized based on scores on a measure of schizotypal traits into separate groups: “schizotypy” – reflecting individuals showing prominent schizotypal traits, “non-schizotypy” – reflecting individuals who, according to the literature (Raine, 1991; Lenzenweger and Korfine, 1992), were very unlikely to be schizotypal, and “unconventional” – reflecting individuals who endorsed some schizotypal-like experiences/behaviors but whose pattern of scores fell below that considered schizotypal. Grouping in this manner directly addresses concerns that the results of prior studies were largely driven by “unconventional” individuals who were not schizotypal in nature.

2. Methods

2.1. Participants

Participants were undergraduate freshman and sophomore students at a large public university in Southern Louisiana who were approached via email to participate in an on-line survey and offered a chance to win one of 10 monetary prizes ($25) for participating. Of the 7951 students invited to participate, our response rate was approximately 27% (n = 2145). Twenty-one percent of these questionnaires were discarded because they were incomplete (n = 467) or invalid (n = 13) defined as responding abnormally to three or more of four questions from the Infrequency Scale (Chapman and Jean, 1976) – e.g., “I believe that most light bulbs are powered by electricity”. The final sample comprised 1665 (64.4% female) students with a mean age of 19.29 (SD = 3.74). The racial/ethnic composition of the sample was as follows: 7.7% African American, 4.3% Asian, 7.2% American Indian, 77.4% Caucasian, and 3.4% Hispanic/Latino. The survey included a consent form, basic demographic questions, and the below measures of schizotypy and cannabis use. The university’s Human Subject Review Board approved this study and informed consent was obtained prior to administration of assessments.

2.2. Schizotypal symptoms

The Schizotypal Personality Questionnaire-Brief Revised (Cohen et al., in press-b) measured schizotypal traits. The SPQ-BR has excellent internal consistency, a coherent factor structure, and demonstrated external validity in a large sample of healthy adults (Cohen et al., in press-b). The SPQ is comprised of 32 items selected from the original SPQ (Raine, 1991) that cohere into seven empirically-derived subscales. The SPQ-BR employs a five-point likert scale system that has been employed in recent SPQ research (Wuthrich and Bates, 2005). Response options ranged from “Strongly Disagree” to “Neutral” to “Strongly Agree.” A super-ordinate four-factor solution has been confirmed in prior research (Cohen et al., in press-b), comprising Cognitive-Perceptual (i.e., ideas or reference/suspicousness, magical thinking and unusual perceptions), Disorganized (eccentric behavior, odd speech), Social Anxiety and Negative (i.e., “no close friends, constricted affect) traits. In light of evidence that the Social Anxiety factor is largely secondary to core schizotypy pathology (Lewandowski et al., 2006; Cohen et al. in press-b, Cohen & Matthews, 2010) and to reduce the total number of analyses examined in this study, we omitted this factor.

Informed by a) Meehl’s theories of schizotypy (Meehl, 1962), b) taxometric studies suggesting a 10% population incidence of Schizotypy (Lenzenweger and Korfine, 1992), and c) findings that over half of individuals in the top 10% of SPQ scorers met criteria for a schizophrenia-spectrum disorder (Raine, 1991), we developed a system for categorizing subjects into three groups based on level of confidence of schizotypy taxon membership. These groups included a “Non-schizotypy” group – comprised of individuals without schizotypal traits (i.e., SPQ-BR scores below the 50th percentile), a “Schizotypy” group – comprised of individuals with prominent schizotypal traits (i.e., SPQ-BR scores above the 95th percentile), and an “Unconventional” group (i.e., defined as cases between the 50th and 85th percentile). The “unconventional” group is meant to capture individuals reporting eccentric traits in some regard (as evidenced by above average SPQ-BR scores) but whose scores were not extreme enough to be considered schizotypal. Individuals with scores between the 85th and 95th percentile were judged to be questionable in terms of categorization and were excluded from the group analyses. Although there are no criteria established in the literature to differentiate these three groups, we are confident that...
our groupings reasonably capture our constructs of interest given they are theoretically and empirically informed. All SPQ-BR scores were statistically corrected for sex and ethnicity.

2.3. Assessment of cannabis use behaviors

Items from the Core Institute’s Campus Assessment of Alcohol and Other Drug Norms assessed frequency of cannabis use. Participants were asked to indicate how often they typically used cannabis. Response options were as follows: daily, nearly every day, 2–3 times per week, 1 time per week, 2–3 times per month, 1 time per month, 3–6 times per year, 1–2 times per year, and never. This measure has been used to successfully assess cannabis use in other reports (e.g., Kilmer et al., 2006). In line with prior work (Aarons et al., 2001; Buckner and Schmidt, 2008a), frequent users were defined as those participants using cannabis at least weekly. The Marijuana Problems Scale (MPS) assessed negative social, occupational, physical, and personal consequences associated with cannabis use in the past 90 days (Stephens et al., 2000). Participants were presented with a list of “different types of problems you may have experienced as a result of smoking marijuana.” The 19 items are rated as either 0 (no problem), 1 (minor problem), or 2 (serious problem). Consistent with Stephens et al. (2000), endorsed items (those rated minor or serious) were counted to create an index of total number of cannabis-related problems. The measure was internally consistent among cannabis users in the present sample ($\alpha = .89$).

2.4. Treatment interest

Participants were asked to rate on a scale of 1 (not at all interested) to 5 (extremely interested) their interest in (1) “receiving treatment that teaches you skills to reduce your marijuana use and/or marijuana-related problems?” and (2) “receiving treatment for other emotional or psychiatric problems?” Dichotomous variables were created such that participants choosing 1 were coded as “not interested” (dummy coded 0) and participants expressing any interest (scores from 2–5) were coded as “interested” (dummy coded 1). Justification for this categorization procedure is as follows. First, as indicated in the extant literature on treatment using Prochaska & DiClemente’s (1982) transtheoretical change model, individuals with no interest in treatment are fundamentally different in terms of treatment response and stage of change than individuals with slight or more interest in treatment (Miller and Rollnick, 1991). Second, from a statistical perspective, using a cutoff point of 2 created the most optimal group sizes compared to other cutoffs. Finally, use of a “2” cutoff score is consistent with recent research using this same assessment strategy to compare treatment seekers to non-treatment seekers in a large college sample (Buckner et al., in press).

2.5. Analyses

The analyses were conducted in five steps. First, we examined potential demographic differences between the schizotypy, unconventional and non-schizotypy groups using analysis of variance (ANOVA)s. Second, we compared the groups in frequency of cannabis use using ANOVA and Chi-square tests. Third, we compared endorsement rates of cannabis-related problems among cannabis users across the three groups using Chi-square analyses. Fourth, we compared treatment interest for cannabis use and for psychiatric treatment more generally between the three groups using Chi-square analysis. Frequent cannabis users versus rare-never users were separately examined in these analyses. Finally, we examined how positive, negative and disorganization traits differed between frequent cannabis users versus rare-never users as a function of schizotypy, unconventional and non-schizotypy group status. A separate group (3 levels) × cannabis use (2 levels) ANOVA was conducted separately for each schizotypy dimension. Evaluation of the interaction term directly speaks to whether the relationship between schizotypy traits and cannabis use differs as a function of schizotypy versus non-schizotypy group status. Unless otherwise noted, dimensional variables are normally distributed.

3. Results

3.1. Demographics

There were no significant differences between the schizotypy and unconventional or non-schizotypy groups in age, sex or ethnicity ($p$’s > .05; see Table 1).

3.2. Comparing groups on cannabis use

Cannabis use was significantly less frequently endorsed in the non-schizotypy ($0.77 \pm 1.76$) versus unconventional ($1.22 \pm 2.27$) and schizotypy ($1.94 \pm 2.53$) groups ($F[2, 1513] = 19.02, p < .001$). When cannabis use was examined as a dichotomous variable (weekly or greater use versus less than weekly), endorsement rates in the schizotypy (21.3%) group were nearly twice that of the unconventional group (12.5%) and nearly four times that of the non-schizotypy group (6.3%) ($\chi^2[2] = 31.03, p < .001$). These results are plotted in Fig. 1.

3.3. Cannabis-related problems

Table 2 contains data on cannabis-related problems compared across the three groups. Because the MPS assesses problems only among those that currently use cannabis, these data include cannabis users only (n’s of schizotypy, unconventional and control groups were 20, 134 and 53 respectively). In general, the schizotypy group endorsed problems at a rate between two and five times that of the other groups. Statistically significant Chi-square values were observed for the following items: problems with significant other and friends, missing work or classes, having lower productivity, withdrawal symptoms, memory loss, sleeping problems, financial difficulties and a range of psychological problems (all p’s < .05). Individuals from the schizotypy group endorsed, on average, over six problems; a rate two to three times that of the other groups. To address concerns that group differences in cannabis-related problems primarily reflected differential cannabis use, we recomputed the group comparisons of total cannabis-related problems while controlling for frequency of cannabis use. The results remained statistically significant ($F[3, 408] = 20.29, p < .001$).

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Non-schizotypy</th>
<th>Unconventional</th>
<th>Schizotypy</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>857</td>
<td>583</td>
<td>99</td>
</tr>
<tr>
<td>Age</td>
<td>19.64 ± 5.85</td>
<td>19.18 ± 1.82</td>
<td>19.70 ± 2.08</td>
</tr>
<tr>
<td>% Male (n)</td>
<td>38.0%</td>
<td>33.3%</td>
<td>40.0%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Caucasian</td>
<td>83.8%</td>
<td>83.0%</td>
<td>86.3%</td>
</tr>
<tr>
<td>% African American</td>
<td>7.6%</td>
<td>8.9%</td>
<td>6.3%</td>
</tr>
<tr>
<td>% other</td>
<td>8.6%</td>
<td>8.9%</td>
<td>6.3%</td>
</tr>
</tbody>
</table>
3.4. Treatment interest

Among rare-never users, interest in treatment for cannabis was, expectedly, quite infrequent but group differences were statistically significant (2.0%, 3.6%, 6.8% for the non-schizotypy, unconventional and schizotypy groups respectively; $\chi^2[2] = 6.85, p < .05$). Among rare-never users there was surprising interest in psychological/psychiatric treatment more generally across all groups, with the vast majority of schizotypal individuals reporting interest in treatment (35.4%, 61.1%, 87.8% for the non-schizotypy, unconventional and schizotypy groups respectively; $\chi^2[2] = 131.89, p < .001$).

Among frequent cannabis users, interest in treatment for cannabis was relatively pronounced but was not significantly different across groups (23.5%, 29.2%, 25.0% for the non-schizotypy, unconventional and schizotypy groups respectively; $\chi^2[2] = .52, p > .10$). Across frequent users there was considerable interest in psychological/psychiatric treatment across all groups, with the vast majority of schizotypal individuals reporting interest in treatment (45.1%, 54.2%, 85.0% for the non-schizotypy, unconventional and schizotypy groups respectively; $\chi^2[2] = 9.32, p < .01$).

There are three notable findings here. First, despite dramatically greater cannabis-related problems among frequent users in the schizotypy versus other groups, interest in treatment for reducing cannabis use was not greater in this group. Second, a substantial majority of individuals with schizotypy reported being interested in psychological/psychiatric treatment, at a significantly higher rate than the other groups. Finally, interest in psychiatric/psychological treatment more generally did not wane as a function of cannabis use in any group, particularly the schizotypy group.

3.5. Schizotypy trait dimensions and cannabis use as a function of schizotypy, unconventional and non-schizotypy group status

Descriptive statistics (in z-score format) for positive, negative, and disorganization traits, computed as a function of group and dichotomized cannabis uses are presented in Table 3. Group differences are not presented here given the tautological nature of this analysis. Significant main effects were noted for the positive (Omnibus $F[1, 1401] = 12.18, p < .001$) and disorganization (Omnibus $F[1, 1401] = 4.54, p < .05$) traits. Frequent users showed more severe traits, but none of the interaction effects were significant ($p's > .05$). Frequent cannabis users, regardless of group, showed significantly more severe positive and disorganization traits. On the other hand, negative traits showed a different pattern. Although frequent users also showed more severe negative traits (Omnibus $F[1, 1401] = 6.99, p < .01$) overall, the group x use interaction was significant ($F[2, 1401] = 4.33, p < .05$). Inspection of the data revealed that, within the schizotypy group, frequent users had significantly fewer severe negative traits ($t[92] = 2.80, p < .05$), in contrast to the unconventional and non-schizotypy groups, for whom frequent users showed slightly, but nonsignificantly more severe negative traits ($p's < .38$). Thus, an inverse relationship between negative schizotypy and cannabis use was observed, but only for the schizotypy group.

4. Discussion

The present study examined cannabis-related characteristics in categorically-defined schizotypy. Categorizing subjects offered greater precision over prior studies employing dimensional definitions of schizotypy (e.g., Bailey and Swallow, 2004; Skosnik et al., 2001) because schizotypal individuals could be separated from individuals who showed sub-threshold unconventional or eccentric traits. We found dramatically greater rates of cannabis use in any group, particularly the schizotypy group.

![Fig. 1. Endorsement of weekly cannabis use as a function of non-schizotypy, unconventional and schizotypy group status.](image)

**Table 2**

Endorsement of cannabis-related problems by cannabis users stratified by putative non-schizotypy, unconventional and schizotypy groups.

<table>
<thead>
<tr>
<th>Cannabis-Related Problems</th>
<th>Schizotypy Group</th>
<th>Non-schizotypy</th>
<th>Unconventional</th>
<th>Schizotypy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problems between you and your partner</td>
<td>1.1%</td>
<td>2.8%</td>
<td>16.7%</td>
<td></td>
</tr>
<tr>
<td>Problems in your family</td>
<td>1.1%</td>
<td>2.8%</td>
<td>4.2%</td>
<td></td>
</tr>
<tr>
<td>To neglect your family</td>
<td>1.1%</td>
<td>.6%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>Problems between you and your friends</td>
<td>.0%</td>
<td>1.7%</td>
<td>10.4%</td>
<td></td>
</tr>
<tr>
<td>Academic–Occupational Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To miss days at work or miss classes</td>
<td>1.6%</td>
<td>2.2%</td>
<td>8.3%</td>
<td></td>
</tr>
<tr>
<td>To lose a job</td>
<td>.5%</td>
<td>1.7%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>To have lower productivity</td>
<td>2.1%</td>
<td>5.6%</td>
<td>12.5%</td>
<td></td>
</tr>
<tr>
<td>Physical Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical problems</td>
<td>.0%</td>
<td>.6%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>Withdrawal symptoms</td>
<td>.0%</td>
<td>1.1%</td>
<td>6.3%</td>
<td></td>
</tr>
<tr>
<td>Blackouts or flashbacks</td>
<td>.0%</td>
<td>1.1%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>Memory loss</td>
<td>.5%</td>
<td>2.8%</td>
<td>10.4%</td>
<td></td>
</tr>
<tr>
<td>Difficulty sleeping</td>
<td>.0%</td>
<td>2.8%</td>
<td>10.4%</td>
<td></td>
</tr>
<tr>
<td>Financial–Legal Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial difficulties</td>
<td>1.1%</td>
<td>1.1%</td>
<td>6.3%</td>
<td></td>
</tr>
<tr>
<td>Legal problems</td>
<td>1.6%</td>
<td>2.2%</td>
<td>.0%</td>
<td></td>
</tr>
<tr>
<td>Psychological Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To have lower energy level</td>
<td>2.6%</td>
<td>2.8%</td>
<td>12.5%</td>
<td></td>
</tr>
<tr>
<td>To feel bad about your use</td>
<td>1.1%</td>
<td>1.7%</td>
<td>10.4%</td>
<td></td>
</tr>
<tr>
<td>Lowered self-esteem</td>
<td>.5%</td>
<td>3.3%</td>
<td>10.6%</td>
<td></td>
</tr>
<tr>
<td>To procrastinate</td>
<td>7.9%</td>
<td>10.0%</td>
<td>25.0%</td>
<td></td>
</tr>
<tr>
<td>To lack self-confidence</td>
<td>.5%</td>
<td>3.3%</td>
<td>10.4%</td>
<td></td>
</tr>
<tr>
<td>Total Number of Cannabis-Related Problems</td>
<td>2.09 ± 3.05</td>
<td>3.57 ± 4.71</td>
<td>6.62 ± 6.93</td>
<td></td>
</tr>
</tbody>
</table>

* Significant group difference Kruskal-Wallace, $p < .05$.  

**Table 3**

Severity of schizotypy trait severity (in z-score format) between weekly cannabis users and rare-never users, stratified by putative non-schizotypy, unconventional and schizotypy groups.

<table>
<thead>
<tr>
<th>Schizotypy Traits</th>
<th>Frequency of Use</th>
<th>Schizotypy Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cannabis use</td>
<td>Non-schizotypy</td>
</tr>
<tr>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-user</td>
<td>-71 ± 62</td>
<td>.37 ± 59</td>
</tr>
<tr>
<td>Negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly user</td>
<td>-49 ± 69</td>
<td>.52 ± 51</td>
</tr>
<tr>
<td>Non-user</td>
<td>-56 ± 69</td>
<td>.32 ± 83</td>
</tr>
<tr>
<td>Disorganized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-user</td>
<td>-64 ± 80</td>
<td>.41 ± 67</td>
</tr>
<tr>
<td>Weekly user</td>
<td>-43 ± 81</td>
<td>.60 ± 66</td>
</tr>
</tbody>
</table>

* Increasing scores reflect more severe traits.  

b Significant group x frequency interaction effect.
Some have proposed that cannabis is employed to reduce social differences in cannabis-related problems were still significant after controlling for cannabis use. Our results suggest that individuals with schizotypy had much more difficulty than other individuals keeping their cannabis use from adversely affecting their lives.

Examination of the relationship between specific schizotypal traits and cannabis use reveals two interesting patterns regarding these variables. First, we did not find that the relationship between positive/disorganization traits and cannabis use was unique to individuals with schizotypy. These traits were no more elevated as a function of cannabis use in the schizotypy group than the other groups. Thus, greater positive/disorganization traits in cannabis users appear to reflect cannabis use more generally rather than a specific interaction with schizotypy. Superficially, this finding runs counter to the idea that cannabis exacerbates psychosis in schizotypy. When interpreted in light of our findings of dramatically more cannabis-related problems in the schizotypy group, it may be that the primary effects of cannabis use in schizotypy involve psychosocial, occupational, academic cognitive or other functional decompen-
sation as opposed to exacerbation of psychotic symptoms. While the cross-sectional nature of our data cannot directly speak to this issue, functional impairment may represent a critical variable for understanding the deleterious effects of cannabis in psychosis-prone individuals.

A second interesting pattern concerns the finding that negative traits were inversely associated with cannabis use for individuals with schizotypy only. This interaction suggests that there is something unique about the relationship between cannabis use and negative traits in individuals with schizotypy. As noted in the introduction, an inverse relationship between cannabis use and negative symptoms has been found in schizophrenia (Kirkpatrick et al., 1996), so it stands to reason that there is a common mechanism across the schizophrenia-spectrum by which these variables are related. Within the schizophrenia literature, many possibilities have been proposed that relate to schizotypy. For example, it could be that individuals with negative traits are less likely to use cannabis due to amotivation, which makes procuring cannabis difficult. Similarly, social anhedonia or asociality may reduce opportunities to use cannabis, as cannabis use is, for many, a social activity (Schaub et al., 2008). From a neurobiological perspective, the effects of cannabis, which involve disruption of the verbal working memory and executive and motivation systems (Morrison et al., 2009), may be frustrating in individuals with negative schizotypy who may already experience dysfunctions in these abilities to some degree. Some have proposed that cannabis is employed to reduce social anxiety in the general population (e.g., Buckner et al., 2006a, 2006b, 2007, 2008b; Buckner and Schmidt, 2008a). This is interesting because some individuals with negative schizotypy are thought be socially apathetic (Cohen & Matthews, 2010); characterized by low levels of social anxiety. In this regard, cannabis use could reflect a strategy for regulating negative affect that is largely unnecessary for individuals with negative schizotypy. Finally, we cannot rule out the possibility that cannabis use ameliorates negative schizotypy traits. We are aware of no compelling empirical support for this, though this has been proposed as a possibility for schizophrenia more generally (Potvin et al., 2006).

Limitations of the present project include the use of a college sample that is by no means representative of all individuals with schizotypy. Although this decision to examine young college adults was guided by data suggesting that young adults, including college students, are particularly vulnerable to using cannabis (Johnston et al., 2007), future work with other populations will be an important next step. Moreover, cannabis use was measured via self-report which is problematic in that subjects may have been less than forthright about their use and cannabis-related problems. Finally, the data was cross-sectional in nature and cannot help disentangle the causal relationships between cannabis use and schizotypy. Two notable possibilities are that cannabis exacerbates schizotypal-related dysfunctions in vulnerable individuals (i.e., cannabis use precedes dysfunction) and that cannabis is being used to self-medicate schizotypal traits or dysfunctions (i.e., schizotypal trait expression or dysfunctions precedes cannabis use). Further research is needed to resolve this issue.

In closing, it is important to discuss the lack of effective treatments for individuals with schizotypy. This is a critical limitation given the distinct possibility that illness trajectory may be altered with effective intervention. Pharmacological interventions have been attempted with “ultra high-risk” individuals — individuals who generally experience symptoms that are much more severe than those experienced by individuals sampled in this study. Notably, these treatment regimens come with unclear efficacy, a host of serious side effects, and social stigma (Cornblatt et al., 2001; Walker et al., 2009; Woods et al., 2003). The present study revealed that nearly every individual with schizotypy was interested in treatment, and that interest in treatment did not wane as a function of cannabis use. We believe that a psychosocial-based treatment for individuals with schizotypy reflects a critical next step in schizophrenia research (Morrison et al., 2007). While a minority of individuals with schizotypy in this study were interested in treatment for cannabis use, integrating treatments to curb cannabis use, perhaps using behavioral (Bellack et al., 2006), and motivational enhancement (Miller and Rollnick, 1991) techniques, may be clinically indicated.

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Contributors

Alex Cohen and Julia Buckner were the primary investigators for this project and designed the study and wrote the bulk of the manuscript. Gina Najolia and Diana Stewart helped manage the literature searches, the analyses and provided conceptual material to the planning and presentation of this project. All authors contributed to and have approved the final manuscript.
Conflicts of interest

There are no conflicts of interest to report.

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