*Cannabis*
2022, Volume 5 (2)

researchmj.org
DOI: 10.26828/cannabis/2022.02.003


# Cannabis's Link to Schizotypy: Phenomenon, Measurement Bias, or Delusion?

**Brianna R. Altman[1], Mitch Earleywine[1], Maha N. Mian[1], Dev K. Dalal[1]**

[1]Department of Psychology, University at Albany, State University of New York, USA

## ABSTRACT

Links between cannabis use and psychosis generate research and media attention. Cannabis users have outscored non-users on the Schizotypal Personality Questionnaire-Brief (SPQ-B) in multiple studies, but previous work suggests that groups do not differ if biased items are removed. The present study examined links between schizotypal personality and cannabis use in a large sample recruited from Amazon's MTurk platform (N = 705). Over 500 participants reported lifetime cannabis exposure. Of those, 259 participants reported current cannabis use, and on average, used 4.53 days per week. Users and non-users failed to differ significantly on total SPQ-B scores or any of the three established subscales. The null results inspired a re-examination of the SPQ-B's factor structure, which identified a novel 3-factor solution (difficulty opening up to others, hyperawareness, and odd or unusual behavior). Only the "odd or unusual behavior" factor showed cannabis-related differences, but a differential item functioning test revealed that one subscale item showed potential bias against users. Removing this item diminished group differences. These results suggest that links between schizotypy and cannabis use require cautious interpretation with careful attention to potential measurement bias. In addition, the SPQ-B might have an alternative factor structure that could help answer important questions in psychopathology.

**Key words**: = cannabis; schizotypy; schizotypal personality disorder

Previous work suggests that cannabis consumption and schizotypy correlate (See Szoke et al., 2014). Cannabis remains the most commonly used federally illicit substance in the United States, with rates increasing in the last several years (Charilaou et al., 2017; Hasin et al., 2017). Approximately 15% of US adults used cannabis in 2017 (Keyhani et al., 2018). Schizotypal personality disorder (SPD), a diagnosis typified by social anxiety, odd behaviors, unusual beliefs (e.g. superstitiousness, clairvoyance), unusual perceptual experiences, and paranoia (American Psychological Association, 2013; Raine & Benishay, 1995), affects approximately four percent of US citizens (Pulay et al., 2009). While only those who meet specific criteria as outlined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) qualify for an SPD diagnosis, schizotypal personality traits appear to exist on a continuum. Initial evidence for an SPD taxon or category failed to replicate once investigators learned to employ modern statistical analyses that included robust simulations and comparable fit indices (Haslam et al., 2020). A large proportion of the population might possess clinically subthreshold schizotypal traits, which are often captured by self-report instruments. These measures often capture schizotypy along three dimensions: negative (interpersonal), positive (cognitive-perceptual), and disorganized.

Covariation between schizotypy and cannabis use consistently exceeds chance, inspiring concerted efforts to explain the link. Some authors view cannabis as a potential cause of symptoms; others view the link as spurious or stemming from measurement problems. Popular writers assert that cannabis causes these symptoms (Berenson, 2020). Other research blames dopaminergic drugs

Corresponding Author: Brianna Altman, Department of Psychology, University at Albany, State University of New York, USA. 1400 Washington Ave. SS 217, Albany, NY, 12203. Phone: (908) 839-2541.
Email: Baltman@albany.edu

(e.g. psychomotor stimulants such as crack and cocaine, ecstasy) that correlate with cannabis consumption for the exaggerated schizotypy symptoms (Van Dam et al., 2008). Longitudinal work reveals that symptoms of schizotypy precede cannabis use, suggesting that self-medication might play a role (Schiffman et al., 2005) but other studies are less clear, citing complicated relations between the dose-dependent effects of cannabis and prior psychiatric vulnerabilities (See Hamilton, 2017). Additional data highlight the potential of other constructs to underlie both cannabis use and symptoms of schizotypy, such as childhood trauma (Airey et al., 2020; Frydecka et al., 2020; Houston et al., 2011; Velikonja et al., 2015). Further, the different dimensions of schizotpy appear differentially related to cannabis use; a meta-analytic review of cross-sectional studies reports that the negative dimension appears least related to cannabis use while the disorganized dimension shows the strongest associations, especially among current cannabis users (Szoke et al., 2014). Continued work examining the etiological underpinnings of cannabis use, schizotypy, and experiences of psychosis is necessary.

Links between cannabis use, schizotypy, and related distress remain unclear; thus, the notion that ending cannabis use might decrease SPD symptoms or negative outcomes might be unfounded. Not all individuals with SPD traits experience symptoms in distressing ways; those higher in schizotypy experience psychotic-like symptoms with less distress than those lower in schizotypy (Kline et al., 2012). Other variables might better account for poor outcomes. Psychotic illnesses covary with cannabis use in a dose-dependent fashion and those afflicted tend to fare poorly if they use cannabis (Hasan et al., 2020). Recent heritability research reveals that lifetime cannabis use and SPD share considerable genetic overlap (Vaissiere et al., 2020), mirroring comparable findings with schizophrenia (Verweij et al., 2017). Nevertheless, despite identification of recent longitudinal links between cannabis use early in life and subsequent development of schizophrenia (Di Forti et al., 2019), links between SPD and schizophrenia are not clear. Many with SPD distinctly do not develop schizophrenia later in life (Debbane et al., 2015). Theoretically, heavy cannabis use might not relate to SPD itself while a significant link to schizophrenia could remain. Heavy users of high-potency strains, for example, might have a psychotic break and qualify for schizophrenia without ever receiving an SPD diagnosis. Thus, the current data could not only help resolve concerns about links between cannabis and SPD, they could also support a focus on potential links with the rarer, and more severe, schizophrenia.

Given the way cannabis intoxication appears to mimic some of the magical ideation and perceptual aberrations common in SPD (Stirling et al., 2008), the idea that the drug contributes to symptoms has considerable appeal. Schizotypy appears to be a better predictor of unusual experiences than cannabis use; however, it is difficult to parse out causal relations between these variables (Airey et al., 2020). Some data show modest increases in schizotypy among cannabis users (Szoke et al., 2014), but SPD traits increase with alcohol and nicotine use as well, perhaps due to deviant attitudes about substance use (Esterberg et al., 2009). Explanations for the link are numerous and few results in the relevant literature seem definitive.

One under-investigated explanation for the link involves measurement bias. Previous work revealed that items from the Schizotypal Personality Questionnaire-Brief (SPQ-B; Raine & Benishay, 1995) had the potential for bias (Differential Item Functioning; DIF) against cannabis users (Earleywine, 2006). Cannabis users were more likely to endorse the item "I sometimes use words in unusual ways," than non-using peers, even after controlling for levels of schizotypy. Dropping the item eliminated significant differences between groups without damaging the scale's internal consistency (Earleywine, 2006). To the authors' knowledge, the aforementioned study remains the only one examining DIF between cannabis users and non-users in measures of schizotypy in the literature. Nevertheless, several studies have examined measurement bias in schizotypy measures, including the Multidimensional Schizotypy Scale and Wisconsin Schizotypy Scales, highlighting the important nature of examining the psychometric properties of such instruments (Cicero et al., 2019; Li et al., 2020). In sum, these results raised the idea that at least the SPQ-B, if not a number of measures of schizotypy, might show cannabis-related differences for reasons beyond the effects of the drug or the disorder. Complex hypotheses about

cannabis playing a role in schizotypy seem inappropriate if the relevant measures are simply biased against cannabis users.

Despite these findings, researchers continue to use the full scale as evidence for a link between cannabis and schizotypy. Given continued concerns about replication in the social sciences (e.g. Ioannidis, 2005), we sought to examine group differences between lifetime and current cannabis users and non-users on the SPQ-B, as well as re-examine the SPQ-B's potential for bias to see if DIF might help explain the link between schizotypy and cannabis consumption again. Replications of DIF are rare (See Embretson & Reise, 2013). The prevalence of cannabis consumption and any associated stigma might also have changed in recent years (Carliner et al., 2017). Links between use of the drug and any deviance might have decreased over time as well, making DIF potentially a moot point. Thus, we examined SPQ-B scores and cannabis use in a large sample. We hypothesized that while cannabis users (both lifetime and current) might initially outscore non-users in their SPQ-B endorsements, these differences might decrease or fail to reach significance should items evidencing DIF be identified and removed. We did not have any a priori hypotheses about which items might be flagged with DIF, given the lack of replication studies of DIF.

# METHODS

*Participants*

Individuals on Amazon's MTurk platform viewed a brief description of the research. Upon providing informed consent, participants were directed to Qualtrics, a survey hosting platform. Only individuals over the age of 18 and living in the United States were permitted to participate; no other exclusion criteria were designated. Participants completed a questionnaire assessing demographics, cannabis use and related problems, and schizotypal personality characteristics. Of the initial 871 participants, 38 were removed for failing to correctly answer attention-check questions. An additional 88 participants responded "No" to the following prompt, "If you did not answer questions honestly or were in someway impaired during this survey, please let us know. You will not be penalized in any way for an honest response to this question. Should we include your data in our analyses?" An additional 40 participants were removed for excessive missing variables, leaving a final sample of $N$ = 705. All study procedures were approved by the local institutional review board.

Table 1. *Sample Demographics*

| Sample Characteristics | *Full Sample (N = 705)* | *Lifetime Users (N = 511)* | *Lifetime Abstainers (N = 194)* | *Current Users (N = 259)* |
|---|---|---|---|---|
| Age (SD) | 36.15 (12.27) | 36.33 (12.45) | 35.68 (11.78) | 35.15 (12.04) |
| % Female | 61.1% | 62% | 58.8% | 60.6% |
| % White | 67.8% | 73% | 54.1% | 66.8% |
| % Bachelors or greater | 48.1% | 44.2% | 58.2% | 40.5% |
| % Lifetime cannabis users | 72.5% | | | |

*Measures*

*Demographics.* Participants reported their age, gender, race/ethnicity, and highest level of education. The average age was 36.15 (SD = 12.27, Range = 18-73). On average, the majority of the sample identified as Caucasian (67.8%) and female (61.1%), with 48.1% ($N$ = 339) reporting attaining a Bachelor's degree or greater (Range = "some high school" to "advanced degree"). Sample characteristics appear in Table 1.

*Cannabis use*. All participants answered the question, "Have you ever used marijuana/cannabis?" Participants who answered "no" to this question were designated as "lifetime non-users." Participants who endorsed lifetime cannabis use ("lifetime users") reported whether they were current users ("current users") or current non-users ("current non-users"), their frequency of cannabis use in the past week and in a typical week, average monthly consumption (in ounces), and average level of intoxication (ranging

from 0 "Not at all" to 7 "Extremely"). Among our sample, 72.5% ($N$= 511) used cannabis at least once in their lifetime. Among lifetime users, 36.7% ($N$ = 259) reported being current users. Current users reported using cannabis approximately 4.53 days per week (SD = 2.58, Range = 0-7), consuming approximately .56 ounces of cannabis per month (SD = .47 ounces, Range = "Less than .025 ounces" to "Greater than 3 ounces") and attaining an average intoxication of 3.93, signifying a moderate typical high (SD = 1.57, Range = 0-7).

*Cannabis problems.* Participants who endorsed lifetime use completed the Cannabis-associated Problems Questionnaire (CAPQ; Lavender et al., 2008). This 19-item measure is derived from the Marijuana Problems Scale (MPS; Stephens et al., 2000; Stephens et al., 1994) to assess for lifetime cannabis-related problems on a scale from 0 ("Not at all") to 5 ("Extremely."). Domains assessed include interpersonal problems, occupational impairment, and physical and psychological health concerns. To measure global cannabis problems, individual items are summed. On average, participants reported mild cannabis-related problems (M = 10.27, SD = 14.80, Range = 0-89). Cronbach's alpha (.942) indicated excellent internal consistency.

*Schizotypal personality.* Participants completed the Schizotypal Personality Questionnaire-Brief (SPQ-B; Raine & Benishay, 1995). This 22-item measure asks individuals to report if a statement applies to them by endorsing either "Yes" (coded as 1) or "No" (coded as 0). Individual items are summed to create a global schizotypy score (Cronbach's alpha = .857) and three subscale scores: cognitive perceptual (alpha =.718), interpersonal deficits (alpha = .776), and disorganized (alpha = .737). The average global score on the SPQ-B was 10.45 (SD = 5.34, Range = 0-22). Average subscale scores were 3.37 (SD = 2.25, Range = 0-8), 4.64 (SD = 2.42, Range = 0-8), and 2.39 (SD = 1.92, Range = 0-6) for the cognitive perceptual, interpersonal deficits, and disorganized subscales, respectively.

### *Data Analytic Plan*

Tests of assumptions for parametric statistics revealed significant positive skew that responded well to Box-Cox transformations (Osborne, 2013). The effort to identify DIF and potential for bias often requires group differences in global or subscale scores, which we assessed using independent samples t-tests. In the absence of significant group differences, we re-examined the factor structure of the SPQ-B and searched for cannabis-related differences on new subscales as a first step toward identifying DIF. Using this new factor structure, we reassessed for group differences, DIF, and relations between the SPQ-B, factor scores, and indices of cannabis use. The exploratory factor analysis was conducted using R; all other analyses were conducted using SPSS Version 25.0.

## RESULTS

### *Examining Differences Between Cannabis Users and Non-users (Lifetime and Current) on the SPQ-B*

T-tests between lifetime cannabis users and non-users on the global SPQ-B and its subscales failed to reach p-values less than < .01 (.05/4; Wilcox, 2013) or Hedge's $g$ values above 0.20. We focus on Hedge's $g$ due to differences in sample size and standard deviations across groups (lifetime users = 511, lifetime non-users = 194). No group differences appeared between lifetime users and lifetime non-users on the aggregated SPQ-B ($t$ = 1.82, $df$ = 668, $p$ = .07; $M_{\text{users}}$ = 10.68, $SD_{\text{users}}$ = 5.30, $M_{\text{nonusers}}$ = 9.84, $SD_{\text{nonusers}}$ = 5.44; $g$ = .157). In fact, a single extra "Yes" answer for each of the lifetime non-users would have raised their mean above the mean of the lifetime users. Similarly, no group differences existed between lifetime users and lifetime non-users for the subscales, including the cognitive-perceptual ($t$ = 2.34, $df$ = 687, $p$ = .63; $g$= 0.20), interpersonal deficits ($t$ = 0.48, $df$ = 689, $p$ = .07; $g$ = .04) or disorganized subscales ($t$ = 2.24, $df$ = 691, $p$ = .03; $g$ = .193).

Similarly, we examined differences between current users and non-users on the SPQ-B and its subscales. Cohen's $d$ effect sizes are reported given similar group sizes and standard deviations. No significant differences were noted in global SPQ-B scores ($t$ = 1.37, $df$ = 484, $p$ = .171, $M_{current}$ = 11.01, $SD_{current}$ = 5.42, $M_{noncurrent}$ = 10.35, $SD_{noncurrent}$ = 5.15, Cohen's $d$ = .12) nor the cognitive-perceptual ($t$ = 1.70, $df$ = 496, $p$ = .090; $d$ = .15), interpersonal deficits ($t$ = -.23, $df$ = 500, p = .82; $d$ = .02), or disorganized subscales ($t$ = 1.90, $df$ = 502, $p$ = .058; $d$ = .17).

Table 2. *SPQ Factor Loadings*

| Item | Factor 1 | Factor 2 | Factor 3 |
|---|---|---|---|
| People sometimes find me aloof and distant. | **.432** | | .290 |
| I feel I have to be on guard even with friends. | **.533** | .274 | |
| Some people find me a bit vague and elusive during a conversation. | **.474** | .109 | .270 |
| I feel very uncomfortable in social situations involving unfamiliar people. | **.824** | -.165 | |
| I tend to keep in the background on social occasions | **.718** | | |
| Do you feel that you are unable to get "close" to people? | **.655** | .137 | |
| I find it hard to communicate clearly what I want to say to people. | **.574** | .149 | .136 |
| I feel very uneasy talking to people I do not know well. | **.746** | | |
| I tend to keep my feelings to myself. | **.755** | -.245 | |
| | | | |
| Have you ever had the sense that some person or force is around you, even though you cannot see anyone? | | **.631** | .108 |
| Are you sometimes sure that other people can tell what you are thinking? | | **.388** | .141 |
| Have you ever noticed a common event or object that seemed to be a special sign for you? | -.148 | **.722** | |
| Do you often pick up hidden threats or put-downs from what people say or do? | .152 | **.608** | |
| When shopping do you get the feeling that other people are taking notice of you? | .215 | **.403** | .129 |
| Have you had experiences with astrology, seeing the future, UFOs, ESP, or a sixth sense? | | **.604** | |
| Do you ever suddenly feel distracted by distant sounds that you are not normally aware of? | .156 | **.402** | .233 |
| Do you often have to keep any eye out to stop people from taking advantage of you? | .286 | **.549** | |
| | | | |
| People sometimes comment on my unusual mannerisms and habits. | | | **.761** |
| Some people think that I am a very bizarre person. | | | **.939** |
| I sometimes use words in unusual ways. | | .212 | **.515** |
| I am an odd, unusual person. | .214 | .110 | **.613** |
| | | | |
| % of Variance | 19.4% | 12.9% | 11.2% |

*Re-Examining the Factor Structure of the SPQ-B*

Given the absence of cannabis-related effects on the standard subscales, we decided to re-examine the factor structure in the current sample. An exploratory factor analysis using tetrachoric correlations was conducted on the SPQ-B using the full sample given our null findings with regard to group differences. Based on visual examination of the scree plot and eigenvalues greater than 1.0, two or three factors appeared to best fit the data. The three-factor model yielded a better fit and accounted for a greater proportion of variance. Thus, only the three-factor model will be described in detail. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (.72) and Bartlett's test of sphericity ($\chi 2 = 675.01$, $df = 171$, $p < .001$) demonstrated that these data were factorable. Three factors with eigenvalues greater than 1.0 (4.26, 2.85, 2.47)

accounted for approximately 49% of the measure's variance. Of the initial 22 items, only one item ("Have you found that it is best not to let other people know too much about you?") had substantial cross-factor loadings (.469 onto Factor 1 and .368 onto Factor 2) and was excluded from analysis. No other items had cross loadings greater than .290 onto more than one factor. Using an oblimin rotation to account for high inter-factor correlations, we determined that nine items loaded onto factor 1, eight items loaded onto factor 2, and four items loaded onto factor 3 with factor loadings of .39 or greater.

Factor 1 accounted for 19.4% of the scale's variance and included items such as, "People sometimes find me aloof and distant" and "Some people find me a bit vague and elusive during a conversation." Based on factor loadings, this factor was named, "Difficulty opening up to others" (Cronbach's alpha = .803). Factor 1 appears similar to the original "Interpersonal" subscale with the addition of two items ("Some people find me a bit vague and elusive during a conversation" and "I find it hard to communicate clearly what I want to say to people") and the exclusion of the item that was removed prior to analysis. Factor 2 accounted for 12.9% of the scale's variance and was comprised of items such as, "Have you ever had the sense some person or force is around you, even though you cannot see anyone?" and "Do you often pick up hidden threats or put-downs from what people say or do?" We named Factor 2 "Hyperawareness" (alpha = .718). Factor 2 matched the original "cognitive-perceptual" SPQ-B subscale. Factor 3 accounted for 11.1% of the scale's variance and was named "Odd or unusual behavior." This factor included items such as, "People sometimes comment on my unusual mannerisms and habits." and "I sometimes use words in unusual ways." Cronbach's alpha was acceptable (.736). Factor 3 appeared similar to the "disorganized" subscale with the exclusion of two items that better mapped onto Factor 1. Factor loadings and cross loadings appear in Table 2. Cronbach's alpha for the shorter, full scale (.851) was nearly identical to the original full scale.

Table 3. *Examining Group Differences on the New SPQ-B Subscales*

| | *t* | $M_{users}$ ($SD_{users}$) | $M_{nonusers}$ ($SD_{nonusers}$) | Effect Size |
|---|---|---|---|---|
| Lifetime users vs. Non-users | | | | |
| 1. "Difficulty opening up to others" | 0.47 | 4.80 (2.74) | 4.69 (2.68) | 0.040 |
| 2. "Hyperawareness" | 2.34 | 3.49 (2.25) | 3.04 (2.25) | 0.200 |
| 3. "Odd or unusual behavior" | 2.91* | 1.71 (1.48) | 1.37 (1.38) | 0.234 |
| Current users. vs. Non-users | | | | |
| 1. "Difficulty opening up to others" | 0.13 | 4.80 (2.80) | 4.80 (2.69) | 0.001 |
| 2. "Hyperawareness" | 1.70 | 3.66 (2.26) | 3.32 (2.23) | 0.152 |
| 3. "Odd or unusual behavior" | 2.25 | 1.86 (1.49) | 1.56 (1.46) | 0.201 |

Note. * $p < .01$

*Group Differences on the SPQ-B's New Subscales*

Our three new factors inspired a second look at differences between lifetime cannabis-users and non-users, as well as current users and non-users. Using the same procedure as the prior analysis, we compared lifetime users and non-users' scores on the subscales with independent samples t-tests corrected using a Bonferroni adjusted p-value of < .01 (.05/4; Wilcox, 2013). Only the "Odd or Unusual Behavior" subscale revealed significant differences, with lifetime users outscoring lifetime non-users ($t = 2.91$, $df = 694$, $p < .01$; $M_{users} = 1.71$, $SD = 1.48$, $M_{nonusers} = 1.37$, $SD = 1.38$, $g = 0.234$). Note that this difference is less than half of one extra "yes" per person on the subscale. Users and non-users scored similarly on the other subscales ($p > .01$; See Table 3). We then compared differences between current users and current non-users; however, no significant differences were noted. ($p > .01$; See Table 3).

*Assessing Differential Item Functioning Among "Odd or Unusual Behavior" Items*

To test for the presence of user-status-based differential item functioning (DIF) in the SPQ-B, logistic regression analyses were conducted to predict each SPQ-B item of Factor 3. Each item was regressed on the centered subscale score, lifetime user status (dummy coded as lifetime users = 0.5, lifetime non-users = -0.5), and the interaction of the subscale score and user status ("Odd or Unusual Subscale" x user status). Should use status significantly predict item scores, the item would demonstrate uniform DIF based on user status. Should the interaction term be a significant predictor of item scores, the item would demonstrate non-uniform DIF. Using an adjusted p-value of .001, only item 19 evidenced uniform DIF based on user status. Even after controlling for the total subscale score, lifetime users were 2.58 times more likely to endorse "yes" to "I am an odd, unusual person" than lifetime non-users (B = .947, SE = .294, Wald = 10.391). This same item had not shown DIF previously (Earleywine, 2006). Removing this item brought the means for the user and non-user groups closer together; they no longer reached statistical significance ($t$=1.81, $df$ = 694, $p$ =0.07; $M_{users}$ = 1.23, $SD$ = 1.16, $M_{nonusers}$ = 1.06, $SD$ = 1.07; $g$ =0.149).

Table 4. *Correlations Among SPQ-B Original Subscales (Raine & Benishay, 1995), New Subscales, and Indices of Cannabis Use*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|---|---|---|---|---|---|---|---|---|---|
| 1. SPQ-B Global | | | | | | | | | |
| 2. Original F1 | .792** | | | | | | | | |
| 3. Original F2 | .816** | .401** | | | | | | | |
| 4. Original F3 | .831** | .537** | .542** | | | | | | |
| 5. New F1 | .836** | .408** | .959** | .636** | | | | | |
| 6. New F2 | .792** | 1.00** | .401** | .537** | .408** | | | | |
| 7. New F3 | .721** | .500** | .391** | .929** | .424** | .500** | | | |
| 8. CAPQ Scores | .317** | .246** | .197** | .324** | .231** | .246** | .286** | | |
| 9. MJ per month | .209** | .155** | .129** | .178** | .132** | .155** | .165** | .332** | |
| 10. Average High | .074 | .066 | .038 | .095* | .044 | .066 | .099* | .268** | .251** |

Note. *$p$ < .05, ** $p$ < .001
SPQ-B Global = Participant responses to the SPQ-B (schizotypy)
Original F1 = Original Factor 1 "Cognitive-perceptual"
Original F2 = Original Factor 2 "Interpersonal deficits"
Original F3 = Original Factor 3 "Disorganized"
New F1 = New Factor 1 "Difficulty opening up to others"
New F2 = New Factor 2 "Hyperawareness"
New F3 = New Factor 3 "Odd or unusual behavior"
CAPQ Scores = Participant responses to the CAPQ (cannabis problems)
MJ Per Month = Quantity of cannabis consumed per month
Average High = Participant's self-reported average level of intoxication

*Assessing Relations Between SPQ-B Scores and Cannabis-Related Variables*

Our newly identified factors were highly correlated with the original three factors proposed by Raine and Benishay in 1995 ($r$'s ranging from .391 to 1.00; all $p$'s < .001; See Table 4). Links between SPQ-B factors and cannabis problems ranged from $r$ = .197 to $r$ = .324. Links with quantity used per month ranged from $r$ = .129 to $r$ = .178 (all $p$'s < .01). Average intoxication appeared only significantly related to the "Odd/unusual factor" ($r$ = .095; $p$ <.05). Age appeared negatively associated with all three subscale scores and the global SPQ-B score; as individuals aged, they appeared to endorse fewer items consistent with SPD ($r$'s ranging from -.136 to -.182; all $p$'s < .01).

## DISCUSSION

Links between cannabis consumption and SPD appear in multiple studies, adding to concerns that the drug might contribute to the etiology of the diagnosis or exacerbate symptoms. But meta-analytic work reviewing 29 studies reveals that many of these studies focus on small samples of college students (11/29), adolescents (3/29) or samples of fewer than 300 participants (18/29; see Szoke et al., 2014). Over a decade ago, data suggested that the SPQ-B (Raine & Benishay, 1995) contained a potentially biased item that shows DIF against cannabis users. This item made cannabis users appear more schizotypal than non-users who were equally schizotypal on all other items. Removing the item eliminated group differences (Earleywine, 2006), casting doubt on the link between cannabis consumption and SPD.

We sought to replicate the link between the SPQ-B and cannabis consumption in a large sample of community participants. Group differences on the global SPQ-B and the original three subscales did not reach statistical significance; lifetime users and current users were as schizotypal as lifetime non-users and current non-users. This finding was somewhat surprising, as numerous studies highlight cannabis users outscoring non-users on measures of schizotypy, especially with regard to cognitive-perceptual symptoms (Esterberg et al., 2009; Fridberg et al., 2011; Schiffman et al., 2005). These null results inspired an additional look at the factor structure. An exploratory factor analysis revealed a comparable three-factor model. The subscale we dubbed "Odd and Unusual Behaviors" showed mean differences between lifetime users and non-users, but one item ("I am an odd, unusual person") showed DIF. Once other indices of schizotypy were covaried out, users were still more than 2.5 times as likely to endorse the item. The result suggests that some aspect of the item other than schizotypy is contributing to endorsement. Item removal decreased lifetime group differences on the subscale to non-significance. Participants might consider themselves odd and unusual in part because of their cannabis use or because of some correlate of use that other SPQ-B items do not address. The previous DIF findings (Earleywine, 2006) suggested a misinterpretation of a comparable item: "I use words in unusual ways."

Although no single cross-sectional study can answer every question about schizotypy's correlates, this second identification of a biased item against lifetime users might encourage careful use of the SPQ-B in future studies. Future work could benefit from close examinations of DIF among cannabis users and non-users. These results suggest that further work on cannabis and psychosis requires considerable cautions, particularly when research employs the SPQ-B. The current results suggest that in a large sample with unbiased subscales, cannabis users and non-users rarely differ from each other on schizotypy or related subscales by more than 1/5 of a standard deviation and the effects disappear when biased items are removed. For a 22-item YES/NO scale like the SPQ-B, this effect size arises from a bit more than one additional YES answer on average among cannabis users (The standard deviation for the whole scale is approximately 5.4). Detecting effects of this size in future work is unlikely with samples of fewer than 600 participants (Cohen, 2013). Given an effect of 0.2, power of .80 with alpha of .05 for a one-tailed test requires 310 participants per group. In the future, those who identify cannabis-related differences on the SPQ-B might provide additional analyses in the absence of items that have shown DIF in previous work, including "I use words in unusual ways," as well as "I am an odd, unusual person." If cannabis-related differences disappear, conclusions about links to schizotypy should be tempered.

Changes to the presentation of these items might also prove illustrative. Although the scale's psychometric properties are clearly superb in many ways (Raine & Benishay, 1995), further work with cannabis users likely requires changes to instructions to avoid misinterpretation of items. Measures of psychotic features frequently emphasize that drug-induced experiences do not qualify as signs or symptoms (APA, 2013). The instructions for the SPQ-B might also benefit from emphasizing that items do not refer to one's identity. Perhaps "I use words, other than cannabis slang, in unusual ways," and "I am an odd, unusual person independent of my cannabis use" are a bit heavy-handed, but the SPQ-B's initial instructions might benefit from emphasizing that participants should not endorse

items that are only true during intoxication or because of identification with a particular subgroup or culture. Elevated schizotypy scores in those who do not share the most prevalent religion of their country might arise for comparable reasons (Hancock & Tiliopoulos, 2010; Tiliopoulos & Johnstone, 2008). If part of schizotypy self-report measures include identifying deviance, the source of the deviance might matter.

Furthermore, our results highlighted significant positive correlations between cannabis use, cannabis-related problems, and both the original and new factors of the SPQ-B. These results were unsurprising, as prior work documents positive associations between cannabis use and self-reported schizotypy (Williams et al., 1996). While those who use more cannabis, or endorse greater cannabis-related problems, might be more likely to endorse schizotypal characteristics, other variables might better account for these significant relations. For instance, as mentioned previously, individuals who use cannabis might have inadvertently misinterpreted instructions and reported on their schizotypal-like experiences during instances of cannabis intoxication. Additionally, extraneous variables such as trauma exposure might help to explain positive links between cannabis use and schizotypy (Airey et al., 2020; Frydecka et al., 2020; Houston et al., 2011; Velikonja et al., 2015). Future work might better assess for known correlates of both cannabis use and schizotypy to control for their influence. Still, despite these significant associations, our work failed to find significant differences between cannabis users and non-users on the SPQ-B.

Like all correlational studies, this one has limitations related to sampling and assessment. The current sample had internet access and was primarily White and educated (see Table 1). Replication efforts are likely worthwhile, as this research question appears important. A huge sample with markedly more participants from understudied populations would undoubtedly strengthen generalization and provide added statistical power for estimating effects related to demographics. For example, only nine Native Americans, an ethnic group with varied but potentially dramatic mental health burden (Asdigian et al., 2018), responded in the current data. Oversampling from groups with less representation would strengthen conclusions considerably. Moreover, given our large sample size, it is likely that a proportion of participants experienced some mental health concerns. Although we did not specifically assess for histories of psychiatric diagnoses, such disorders might influence endorsements of schizotypy or cannabis use. For instance, data highlight associations between experiences of anxiety and depression and self-reported schizotypy (Kemp et al., 2018; Lewandowski et al., 2006). Future work might assess for the presence of such symptoms and potentially control for these variables should they show significant correlations with schizotypy.

Additionally, the measures of both schizotypy and cannabis use were all self-report. Although stigma around cannabis consumption might have decreased recently (Carliner et al., 2017), biological confirmation of cannabis consumption might have advantages. Future work might more thoroughly assess important aspects of cannabis use (e.g., type of products used, THC concentration), and attitudes regarding substance use more broadly, as they relate to schizotypy and cannabis problems. Furthermore, the concept of socially desirable responding, especially as it relates to endorsements of cannabis-related problems, calls for careful interpretation of these findings, given the mild cannabis problems reported by this sample. Nevertheless, the current results cast doubt on links between cannabis use and schizotypy, at least as measured by the SPQ-B. Future work might benefit from examinations of DIF in other measures of schizotypy, such as the full-scale SPQ and the Oxford-Liverpool Inventory of Feelings and Life (O-LIFE; Mason et al., 1995), as well as modest changes in assessment instructions. The presence of these measurement problems suggests that current estimates of links between cannabis use and schizotypy might be overestimates.

A final limitation of this work relates to the dichotomous nature of the SPQ-B. The SPQ-B asks participants to endorse whether a symptom of SPD applies to their experience on a "Yes/No" scale. Given these instructions, researchers are unable to ascertain whether an item currently applies to a participant or had previously applied. The approach also has the potential to neglect variation in symptom intensity. For instance, "People sometimes find me aloof and distant" might have applied to a person's experience in the

past, but not currently. This person might still endorse "Yes" to this item, given the scale instructions. Continued longitudinal work can disentangle relations between ongoing cannabis use and current presence of SPD features. Alternative response formats for the SPQ-B, such as that employed by the Schizotypal Personality Questionnaire – Brief Revised (SPQ-BR; Cohen et al., 2010), might also provide finer distinctions in symptom intensity. The SPQ-BR asks participants to rate their agreement with items on a scale from "Strongly Disagree" to "Strongly Agree." By allowing for greater variance in responses, researchers might be able to better assess the strength of relations between cannabis use and schizotypy. Nevertheless, the current findings suggest that any links between cannabis use and schizotypy are likely small and could arise because of measurement bias. Thus, attempts to limit schizotypy or its impact will likely not benefit most from minimizing cannabis consumption.

## REFERENCES


Airey, N.D., Hammersley, R., & Reid, M. (2020). Schizotypy but not cannabis use modestly predicts psychotogenic experiences: A cross-sectional study using the Oxford-Liverpool Inventory of Feelings and Life (O-Life*). Journal of Addiction*, 2020.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington (VA): Author.

Asdigian, N.L., Bear, U.R., Beals, J., Manson, S.M., & Kaufman C.E. (2018). Mental health burden in a national sample of American Indian and Alaska native adults: Differences between multiple-race and single-race subgroups. *Social Psychiatry and Psychiatric Epidemiology, 53*(5), 521–530.

Berenson A. (2020). Tell your children: The truth about marijuana, mental illness, and violence. New York (NY): Free Press

Carliner, H., Brown, Q.L., Sarvet, A.L., & Hasin, D.S. (2017). Cannabis use, attitudes, and legal status in the US: A review. *Preventive Medicine, 104*, 13-23.

Charilaou, P., Agnihotri, K., Garcia, P., Badheka, A., Frenia, D., & Yegneswaran, B. (2017). Trends of cannabis use disorder in the inpatient: 2002 to 2011. *American Journal of Medicine*, *130*(6), 678-687.

Cicero, D. C., Martin, E. A., & Krieg, A. (2019). Differential item functioning of the full and brief Wisconsin Schizotypy Scales in Asian, White, Hispanic, and multiethnic samples and between sexes. *Assessment*, *26*(6), 1001-1013.

Cohen J. (2013). Statistical power analysis for the behavioral sciences. New York (NY): Academic Press.

Cohen, A.S., Matthews, R.A., Najolia, G.M., & Brown, L.A. (2010). Toward a more psychometrically sound brief measure of schizotypal traits: Introducing the SPQ-Brief Revised. *Journal of Personality Disorders, 24*, 516-537.

Debbané, M., Eliez, S., Badoud, D., Conus, P., Flückiger, R., & Schultze-Lutter, F. (2015). Developing psychosis and its risk states through the lens of schizotypy. *Schizophrenia Bulletin*, *41*(suppl_2), S396-S407.

Di Forti, M., Quattrone, D., Freeman, T.P., Tripoli, G., Gayer-Anderson, C., Quigley, H., Rodriguez, V., Jongsma, H.E., Ferraro, L., La Cascia, C., La Barbera, D., Tarricone, I., Berardi, D., Szoke, A., Arango, C., Tortelli, A., Velthorst, E., Bernardo, M., Del-Ben, C.M., … the EU-GEI WP2 Group. (2019). The contribution of cannabis use to variation in the incidence of psychotic disorder across Europe (EU-GEI): A multicentre case-control study. *The Lancet Psychiatry, 6*(5), 427-436.

Earleywine, M. (2006). Schizotypy, marijuana, and differential item functioning. *Human Psychopharmacology: Clinical and Experimental, 21*(7), 455-461.

Embretson, S.E., & Reise, S.P. (2013). Item response theory. Psychology Press.

Esterberg, M.L., Goulding, S.M., McClure-Tone, E.B., & Compton, M.T. (2009). Schizotypy and nicotine, alcohol, and cannabis use in a non-psychiatric sample. *Addictive Behaviors*, *34*(4), 374-379.

Fridberg, D. J., Vollmer, J. M., O'Donnell, B. F., & Skosnik, P. D. (2011). Cannabis users differ from non-users on measures of personality and schizotypy. *Psychiatry Research*, *186*(1), 46-52.

Frydecka, D., Misiak, B., Kotowicz, K., Pionke, R., Krężołek, M., Cechnicki, A., & Gaweda, L. (2020). The interplay between childhood trauma, cognitive biases, and cannabis use on

the risk of psychosis in nonclinical young adults in Poland. *European Psychiatry*, *63*(1), e35.

Hamilton, I. (2017). Cannabis, psychosis and schizophrenia: Unravelling a complex interaction. *Addiction*, *112*(9),1653-1657.

Hancock, L., & Tiliopoulos, N. (2010). Religious attachment dimensions and schizotypal personality traits. *Mental Health, Religion, & Culture, 13*(3), 261-265.

Hasan, A., von Keller, R., Friemel, C.M., Hall, W., Schneider, M., Koethe. D., Leweke, F.M., Strube, W., & Hoch, E. (2020). Cannabis use and psychosis: A review of reviews. *European Archives of Psychiatry and Clinical Neuroscience, 270*(4), 403-412.

Hasin, D.S., Sarvet, A.L., Cerdá, M., Keyes, K.M., Stohl, M., Galea, S., & Wall M.M. (2017). US adult illicit cannabis use, cannabis use disorder, and medical marijuana laws: 1991-1992 to 2012-2013. *Jama Psychiatry*, *74*(6), 579-588.

Haslam, N., McGrath, M. J., Viechtbauer, W., & Kuppens, P. (2020). Dimensions over categories: A meta-analysis of taxometric research. *Psychological Medicine*, *50*(9), 1418-1432.

Houston, J.E., Murphy, J., Shevlin, M., & Adamson, G. (2011). Cannabis use and psychosis: Revisiting the role of childhood trauma. *Psychological Medicine, 41*, 2339-2348.

Ioannidis, J.P. (2005). Why most published research findings are false. *PLoS Medicine*, *2*(8), e124.

Kemp, K. C., Gross, G. M., Barrantes-Vidal, N., & Kwapil, T. R. (2018). Association of positive, negative, and disorganized schizotypy dimensions with affective symptoms and experiences. *Psychiatry Research*, *270*, 1143-1149.

Keyhani, S., Steigerwald, S., Ishida, J., Vali, M., Cerdá, M., Hasin, D., Dollinger, C., Yoo, S.R., & Cohen, B.E. (2018). Risks and benefits of marijuana use: A national survey of US adults. *Annals of Internal Medicine*, *169*(5), 282-290.

Kline, E., Wilson, C., Ereshefsky, S., Nugent, K.L., Pitts, S., Reeves, G., & Schiffman, J. (2012). Schizotypy, psychotic-like experiences and distress: An interaction model. *Psychiatry Research, 20*(2-3), 647-651.

Lavender, J.M., Looby, A., & Earleywine, M. (2008). A brief cannabis-associated problems scale with less potential for bias. *Human Psychopharmacology: Clinical and Experimental, 23,* 487-493.

Lewandowski, K. E., Barrantes-Vidal, N., Nelson-Gray, R. O., Clancy, C., Kepley, H. O., & Kwapil, T. R. (2006). Anxiety and depression symptoms in psychometrically identified schizotypy. *Schizophrenia Research*, *83*(2-3), 225-235.

Li, L. Y., Meyer, M. S., Martin, E. A., Gross, G. M., Kwapil, T. R., & Cicero, D. C. (2020). Differential item functioning of the Multidimensional Schizotypy Scale and Multidimensional Scale-Brief across ethnicity. *Psychological Assessment*, *32*(4), 383.

Mason, O., Claridge, G., & Jackson, M. (1995). New scales for the assessment of schizotypy. *Personality and Individual Differences, 18*(1), 7-13.

Osborne, J.W. (2013). Best practices in data cleaning. Thousand Oaks (CA): Sage.

Pulay, A.J., Stinson, F.S., Dawson, D.A., Goldstein, R.B., Chou, S.P., Huang, B., Saha, T.D., Smith, S.M., Pickering, R.P., Ruan, W.J., & Hasin, D.S. (2009). Prevalence, correlates, disability, and comorbidity of DSM-IV schizotypal personality disorder: Results from the wave 2 national epidemiologic survey on alcohol and related conditions. *The Primary Care Companion to the Journal of Clinical Psychiatry, 11*(2), 53-67.

Raine, A., & Benishay, D. (1995). The SPQ-B: A brief screening instrument for schizotypal personality disorder. *Journal of Personality Disorders, 9*(4), 346-355.

Schiffman, J., Nakamura, B., Earleywine, M., & LaBrie, J. (2005). Symptoms of schizotypy precede cannabis use. *Psychiatry Research, 134*(1), 37-42.

Stephens, R.S., Roffman, R.A., & Curtin L. (2000). Comparison of extended versus brief treatments for marijuana use. *Journal of Consulting and Clinical Psychology*, *61*, 1100-1104.

Stephens, R.S., Roffman, R.A., & Simpson, E.E. (1994). Treating adult marijuana dependence: A test of the relapse prevention model. Journal of Consulting and Clinical Psychology, *62*, 92-99.

Stirling, J., Barkus, E.J., Nabosi, L., Irshad, S., Roemer, G., Schreudergoidheijt. B., & Lewis, S. (2008). Cannabis-induced psychotic-like experiences are predicted by high schizotypy. *Psychopathology*, *41*(6), 371-378.

Szoke, A., Galliot, A.M., Richard, J.R., Ferchiou, A., Baudin, G., Leboyer, M., & Schürhoff, F. (2014). Association between cannabis use and schizotypal dimensions–a meta-analysis of cross-sectional studies. *Psychiatry Research, 219*(1), 58-66.

Tiliopoulos, N., & Johnstone, J. (2008). Exploring the relationship between schizotypal personality traits and religious attitude in an international Muslim sample. *Archive for the Psychology of Religion*, *30*(1), 241-253.

Vaissiere, J., Thorp, J.G., Ong, J.S., Ortega-Alonzo, A., & Derks, E.M. (2020). Exploring phenotypic and genetic overlap between cannabis use and schizotypy. *Twin Research and Human Genetics*, *23*(4), 221-227.

Van Dam, N.T., Earleywine, M., & DiGiacomo, G. (2008). Polydrug use, cannabis, and psychosis-like symptoms. *Human Psychopharmacology: Clinical and Experimental, 23*(6), 475-485.

Velikonja, T., Fisher, H.L., Mason, O., & Johnson, S. (2015). Childhood trauma and schizotypy: A systematic literature review. *Psychological Medicine, 45*(5), 947-963.

Verweij, K.J., Abdellaoui, A., Nivard, M.G., Cort, A.S., Ligthart, L., Draisma, H.M., Minică, C.C., International Cannabis Consortium, Gillespie, N.A., Willemsen, G., Hottenga, J.J., Boomsma, D.I., & Vink, J.M. (2017). Genetic association between schizophrenia and cannabis use. *Drug and Alcohol Dependence, 171*,117-121.

Wilcox, R.R. (2013). New statistical procedures for the social sciences: Modern solutions to basic problems. Florence (KY): Psychology Press.

**Funding and Acknowledgements:** The authors have no disclosures or conflicts of interest to report.