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Risk-taking in schizophrenia and controls with and without cannabis dependence

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Abstract

Background—Risk-based decision making is altered in people with schizophrenia and in people with cannabis use compared to healthy controls; the pattern of risk-assessment in people with co-occurring schizophrenia and cannabis dependence is poorly understood. This study examined measures of risk-taking and decision-making in people with and without schizophrenia and/or cannabis dependence.

Methods—Participants with schizophrenia (n=24), cannabis dependence (n=23), schizophrenia and co-occurring cannabis dependence (n=18), and healthy controls (n=24) were recruited from the community via advertisements and completed a one-visit battery of symptom, risk-based decision making, gambling behavior, cognitive, and addiction assessments. This report presents self-assessments of self-mastery, optimism, impulsivity, and sensation seeking and a behavioral assessment of risk (Balloon Analog Risk Task [BART]).

Results—On self-report measures, participants with schizophrenia and co-occurring cannabis dependence were intermediate between those with only cannabis dependence or only schizophrenia on ratings of self-mastery, sensation-seeking, and impulsivity. There were no group

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Contributors

Drs. Fischer, Gorelick, and Carpenter designed the study and wrote the protocol. Dr. McMahon and Mr. Meyer conducted the statistical analyses. Drs. Fischer, Gorelick, Carpenter, McMahon, Kelly, and Wehring and Ms. Feldman interpreted the results. Dr. Fischer wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflict of interest.

differences on ratings of optimism. Their behavior on the BART was most similar to participants with only cannabis dependence or healthy controls, rather than to participants with only schizophrenia.

Conclusions—People with schizophrenia and co-occurring cannabis dependence may represent a unique group in terms of risk-perception and risk-taking. This has implications for interventions designed to influence health behaviors such as motivational interviewing.

Keywords

schizophrenia; cannabis dependence; co-occurring disorders; risk-taking; decision-making; impulsivity

1. Introduction

Personal choices have substantial influence on health--from diet to unprotected sex to drunk driving. By studying how people evaluate risk when making choices, we might prevent many accidents and diseases. Healthy adults often exhibit unrealistic optimism when evaluating risk (Prentice et al., 2005; Rutter et al., 1998; Weinstein, 1984; Weinstein et al., 2005). This bias takes the form of imagining that others are more at risk than one's self for negative events. A major reason for this optimistic bias is that the imagined comparison group is often an especially at-risk population (Rothman et al., 1996; van der Pligt, 1994). Unrealistic optimism is also greater for events that one believes are under personal control versus uncontrollable or random events (Prentice et al., 2005; van der Pligt, 1994; Zakay, 1996). People overestimate the effect of their own mitigating behavior, while underestimating the effects of others' behaviors (Greening and Chandler, 1997; Rothman et al., 1996; van der Pligt, 1994). In addition to weighing the probability of adverse consequences, risky decisions are influenced by tendencies towards impulsivity and sensation-seeking.

We are not aware of any published studies on optimistic bias in cannabis users, but multiple studies have assessed risk-taking propensity in this group. Compared to non-using controls, frequent cannabis users report more impulsivity on self-ratings (Gerra et al., 2004; Griffith-Lendering et al., 2012; Moreno et al., 2012; Solowij et al., 2012). Heavy cannabis users (use 25 out of 30 days, ≥ five years), compared to non-using controls, demonstrate more difficulties balancing rewards with losses on gambling tasks (Whitlow et al., 2004). Yet, at least one study found no differences between young adult cannabis users and non-users in laboratory measures of impulsivity (Gonzalez et al., 2012).

Compared to healthy controls, people with schizophrenia show less optimistic bias (Prentice et al., 2005). This may reflect a more external locus of control, i.e., less conviction they can effect change in personal risk. People with schizophrenia also show higher self-report and behavioral-based measures of impulsivity (Hutton et al., 2002; Kaladjian et al., 2011; Nolan et al., 2011).

Cannabis is the most widely used illicit drug among people with schizophrenia (Westermeyer, 2006). About 20% of people with first-episode schizophrenia are regular-to-daily cannabis users (Faber et al., 2012; Wobrock et al., 2013). However, little is known

about risk-perception and risk-related behaviors of people with co-occurring schizophrenia and cannabis dependence. One of the few studies of impulsivity and sensation-seeking in this population found that a group with schizophrenia and a lifetime history of cannabis use disorder had higher self-ratings of sensation-seeking and impulsivity than a group with schizophrenia alone (Dervaux et al., 2010). All participants were males and, as inpatients, the co-morbid group was not necessarily using cannabis at the time of assessment.

The present study measured several aspects of risk-perception in people with schizophrenia only (Sz), cannabis dependence only (Cb), co-occurring schizophrenia and cannabis dependence (SzCb), and healthy controls (HC). Specifically, we measured self-reported degree of perceived control over life (self-mastery), insight into illness, optimistic bias, impulsivity, and sensation-seeking. We also assessed actual risk-taking behavior. We hypothesized that the Sz group would show less self-mastery, optimistic bias, and sensation-seeking, but greater impulsivity, than HCs; that the Cb group would report more self-mastery, optimistic bias, impulsivity, and sensation-seeking than HCs; and that the comorbid SzCb group would show intermediate scores on self-mastery, optimistic bias, and sensation-seeking, but greater impulsivity, compared to the Sz and Cb groups. These results would translate into increased risky behavior on the behavioral test in all three illness groups when compared to HCs.

2. Methods

2.1 Participants

Potentially eligible participants were referred from existing studies and clinical programs at the Maryland Psychiatric Research Center (MPRC), University of Maryland, Baltimore (UMB) and the National Institute on Drug Abuse (NIDA) and recruited from the community by IRB-approved advertisements. Applicants were screened with the Structured Clinical Interview for DSM-IV (First et al., 1997) to assess for Axis I disorders and an internally developed Drug and Alcohol Use Survey (DAUS) to assess substance use patterns.

Inclusion criteria for all groups were 18–64 years old and ability to provide valid informed consent. Exclusion criteria for all groups were history of neurological disease, documented mental retardation, or physical impairment preventing computerized testing. HC participants were excluded for any current Axis I disorder other than simple phobia, any current drug dependence other than nicotine, or use of illicit drugs > three times in the previous month. Sz participants required a diagnosis of current schizophrenia/schizoaffective disorder (DSM-IV criteria), and were excluded for any current mood disorder, obsessive-compulsive disorder, drug dependence other than nicotine, or use of illicit drugs > three times in the previous month. Cb participants required a diagnosis of current cannabis dependence (DSM-IV criteria), and were excluded for any current mood disorder, obsessive compulsive disorder, schizophrenia, or schizoaffective disorder. SzCb participants required a diagnosis of current schizophrenia/schizoaffective disorder and cannabis dependence, and were excluded for any current mood disorder or obsessive-compulsive disorder. All participants with schizophrenia were required to be on the same dose of the same medication for the previous four weeks.

This study was approved by the Institutional Review Boards of UMB and NIDA. Written documentation of informed consent was obtained from each participant when clinically stable and not acutely psychotic or intoxicated.

2.2 Design

Participants were administered assessments at a one-day visit. This report highlights the risk-assessment scales/laboratory data. Data on self-reported gambling behavior will be presented separately.

2.3 Self-Report Scales

The Scale to Assess Unawareness of Mental Disorder (SUMD) (Amador et al., 1993) was used to evaluate insight in the schizophrenia groups.

The Self-Mastery Scale (SMS) was used to assess locus of control (Pearlin and Schooler, 1978). The SMS is a 7-item measure of the extent to which individuals perceive mastery over life outcomes. Each item is rated 1–5; higher scores indicate more feelings of self-mastery.

Optimism was measured using the Revised Life Orientation Test (LOT-R) (Scheier et al., 1994). The LOT-R contains 10 items, of which 4 are unscored filler items. Each item is rated 1–5; higher scores indicate more life optimism.

Risk perception was assessed with two instruments: the Risk Perception Questionnaire (Prentice et al., 2005) and six risk perception questions described by Cherpitel (1993). The Risk Perception Questionnaire includes 40 different events: 14 each are controllable (e.g., being injured from not wearing a seatbelt) or uncontrollable (e.g., experiencing an earthquake) and 12 are neutral (e.g., getting a dog bite requiring treatment). Individuals rate how likely each event is to happen to them in their lifetime, compared to other adults of the same age and gender, on a -3 (much less likely) to +3 (much more likely) scale, with 0 being equally likely. Lower scores indicate more optimism. The Cherpitel risk perception questions, developed from a factor analysis of data from a large study on alcoholism, asks the individual to rate how likely it is that a bad outcome will follow each of 6 poor choices. Each item is rated 1 (very unlikely) to 5 (very likely). Lower scores indicate more optimism.

Impulsivity and sensation-seeking were measured using the relevant items from the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ-Imp & ZKPQ-SS) (Zuckerman, 2002), as well as five Risk-Taking/Impulsivity and four Sensation-Seeking questions described by Cherpitel (1993). The ZKPQ-Imp contains 8 items (numbers 1, 6, 14, 19, 29, 39, 84, and 89 in ZKPQ) and the ZKPQ-SS 11 items (numbers 24, 34, 45, 50, 55, 60, 65, 70, 75, 79, and 95 in ZKPQ) - each rated as true or false. Each Cherpitel question is rated 1–4. Higher scores on each scale indicate more impulsivity/sensation-seeking.

2.4 Laboratory Behavioral Assessment

The Balloon Analogue Risk Task (BART) was used to assess actual risk-taking behavior (Lejuez et al., 2002). Individuals are presented with a simulated balloon and pump on a computer screen. Each press of a button inflates the balloon slightly and earns the participant

2 cents. The money is deposited into a temporary cache visible on-screen. At any time before the balloon pops, the participant can stop inflating the balloon and collect the money in the temporary cache- which is then deposited in a permanent bank (also displayed on-screen). If the balloon pops, all money in the temporary cache is lost. The point at which balloons pop is based on a curve function and not predictable for any individual balloon. The object of the game is to earn as much money as possible. The trial consisted of 30 balloons. We recorded the number of balloon pumps and balloon explosions as measures of risk-taking behavior and amount of money earned as an indication of overall strategy. Participants received actual money for this task.

2.5 Other Assessments

The Brief Psychiatric Rating Scale (BPRS) (Overall and Gorham, 1962) and its positive symptom items subscale (conceptual disorganization, hallucinations, unusual thought content, and suspiciousness) were used to measure psychopathology. Cognitive abilities were assessed using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) (Gold et al., 1999) and the Wexler Test of Adult Reading (WTAR; Psychological Corporation, 2001). Exhaled breath carbon monoxide (CO) was measured as an indication of smoking on the day of assessments. The DAUS was used to measure alcohol use in the 2 weeks prior to screening and lifetime drug experience. Information on current anti-psychotic medication and lifetime alcohol use disorders was obtained by medical record review.

2.6 Statistical Analysis

Departures from normality for continuous variables were tested with the Shapiro-Wilk test (Shapiro and Wilk, 1965) applied to the pooled residuals from all four groups, after fitting a one-way ANOVA model comparing groups. For variables without significant departure from normality, groups were compared using ANOVA tests, with post hoc t-tests from the ANOVA model used for pair-wise comparisons to further evaluate a significant effect. For continuous measures that were non-normally distributed, Kruskal-Wallis tests were performed to determine overall differences among the groups; where such overall tests were significant, pair-wise differences between groups were evaluated with the Wilcoxon test. Group differences on categorical variables were evaluated using the chi-square test. All statistical analyses were performed using SAS version 9.3 (SAS Institute, Inc., Cary, NC).

As this was a preliminary study with small sample sizes, no adjustments were made for multiple comparisons to avoid type II errors and missing possible leads for further investigation (Feise, 2002; Rothman, 1990). The small sample sizes made it impossible to use multivariable analyses to control for possible confounding by observed group differences in baseline characteristics such as gender and age.

3. Results

Ninety-one participants enrolled in the study; two with cocaine dependence but not cannabis dependence (one with schizophrenia; one without) were excluded from analysis to maintain homogenous drug-using groups.

The four groups differed significantly in several baseline characteristics (Table 1). In particular, the HC group had a greater proportion of women, higher level of education, and better cognitive performance. The Sz group was 10 -13 years older on average than the other three groups. There were no symptom differences between the schizophrenia groups.

Information on anti-psychotic medication was available for 17 (71%) participants in the Sz group and 5 (26%) participants in the Sz/Cb group. Among the former, 3 (18%) were taking a 1st generation anti-psychotic, 4 (24%) clozapine, 7 (41%) another 2nd generation anti-psychotic, 2 (12%) both a 1st and 2nd generation anti-psychotic, and 1 (6%) no anti-psychotic. Among the latter, 1 (20%) was taking a 1st generation anti-psychotic, 2 (40%) a 2nd generation anti-psychotic, and 2 (40%) no anti-psychotic.

Urine toxicology results for cannabis were consistent with group assignment in terms of recent cannabis use (Table 2). However, a majority of participants in all groups had used cannabis at least once in their lifetime (Table 2). Expired breath CO was lower in the HC group than in the other three groups (Table 2). Recent alcohol use was significantly higher in the two cannabis-dependent groups (Table 2), but the prevalence of lifetime alcohol use disorder (abuse or dependence) was very low (5.6%): 4 participants in the Sz group (all in full or partial remission) and 1 participant in the Cb group.

The Sz and SzCb groups did not differ on insight into illness (Table 3).

The HC group had higher self-mastery scores than the SzCb and Sz groups; the Cb group had higher scores than the Sz group.

There were no significant group differences in measured optimism or risk perception.

The HC group reported less impulsivity than the other three groups, although the differences were statistically significant only for ZKPQ-Imp. The two cannabis-dependent groups reported more sensation-seeking than the Sz or HC groups, but these differences were significant only on the Cherpitel Sensation-Seeking questions.

The Sz group made significantly fewer balloon pumps and had fewer balloon explosions on the BART than the other three groups. There were no other significant group differences on balloon pumps or explosions, nor any significant group differences in money earned.

4. Discussion

Our results were only partially consistent with our hypotheses. We expected the SZ group to report less self-mastery, optimistic bias, and sensation-seeking, but greater impulsivity, than HCs. Only the first and last hypotheses were confirmed. The Sz group did not have less optimistic bias than other groups. This contrasts with a previous study (Prentice et al., 2005), but is consistent with the lack of significant difference on the LOT-R and the Cherpital Risk Perception questions. Prentice and colleagues found higher levels of depressive symptoms were associated with less optimistic bias in their sample. If depressive symptoms have more impact on optimistic bias than the diagnosis of schizophrenia, per se, our results might

reflect different levels of depressive symptomatology across groups compared to Prentice et al.

We expected more self-mastery, optimistic bias, impulsivity, and sensation-seeking in the Cb than HC group. Only the last two hypotheses were confirmed. We expected more self-mastery and optimistic bias in this group because we hypothesized these factors would help explain continued cannabis use despite the likelihood of negative consequences. However, a study of optimistic bias in injection drug users showed no difference from controls for most imagined outcomes and that bias is actually less pronounced for potentially negative effects related to drug use (i.e., people using drugs agree that they are more vulnerable to negative outcomes from activities like unprotected sex compared to others (Marsch et al., 2007)). This study and our own results indicate that increased optimistic bias is not necessary for continued drug use and that bias among those with drug dependence may not differ from healthy controls in most instances.

We expected the comorbid SzCb group to show higher impulsivity than other groups and intermediate levels of self-mastery, optimistic bias, and sensation-seeking versus Sz and Cb groups. Although most data trends were in the hypothesized direction, none of these differences were statistically significant. Impulsivity, where the data trends also showed an intermediate mean between the Sz and Cb groups, was not additive as predicted. This result is surprising considering that more impulsivity has been found in people with schizophrenia and a lifetime history of cannabis and other substance use disorders (Dervaux et al., 2001; Dervaux et al., 2010; Gut-Fayand et al., 2001). These different findings may be due, in part, to use of different self-report measures of impulsivity. The prior studies used the Barratt Impulsivity Scale and/or the complete Zuckerman Sensation-Seeking Scale, whereas the present study used only selected items from the ZKPQ.

Other studies in dual-disordered groups have failed to find a clear difference in impulsivity between individuals with schizophrenia-only and those with schizophrenia and a comorbid substance use disorder. Zhornitsky and colleagues found no difference in impulsivity among schizophrenia-alone, substance using-alone (cannabis or alcohol), and co-morbid groups-which were all more impulsive than healthy controls (2012). Likewise, Duva et al. obtained mixed results using multiple measures of impulsivity in groups with schizophrenia, schizophrenia with current cocaine abuse, and schizophrenia with a history of cocaine abuse; some measures showing increased impulsivity in the substance abusing groups, some showing no group differences (Duva et al., 2011). The relationship between impulsivity and drug use, especially in schizophrenia, is unknown and perhaps bidirectional (Duva et al., 2011; de Wit, 2008). Baseline impulsivity may influence an individual's drug use, but drug use may also affect ratings of impulsivity. Because some people in both of our control groups (Sz and HC) had prior experience with cannabis, and lifetime cannabis use was not quantified, it is possible that group differences were smaller than they would have been if our control groups had no prior use of cannabis.

On the BART, we expected the HC group to have less risk-taking behavior (i.e., fewer balloon pumps and balloon explosions) than the illness groups. Contrary to our hypothesis, the Sz group had significantly less risk-taking behavior than the other groups. There are

several possible explanations for this finding. Generalized motor slowing in the Sz group is unlikely to explain this difference, as the BART is not timed. Antipsychotic use is also unlikely to explain this difference as the SzCb group was also on antipsychotics. Less impulsivity in the Sz group is inconsistent with our findings on the ZKPQ-Imp, where the HC group was the least impulsive and the Sz group did not differ from SzCb or Cb groups. Decreased sensitivity to reward is possible; however, Heerey and colleagues (2008) found that people with schizophrenia had intact reward sensitivity, but still demonstrated difficulties integrating reward value into decision-making tasks. This integration difficulty has been cited to explain a similar risk-averse pattern observed on the BART in another study of schizophrenia versus healthy controls (Cheng et al., 2012). The SzCb group did not differ from the Cb or HC groups, suggesting that perhaps this integration problem is less severe or absent in people with schizophrenia who are also dependent on cannabis.

Overall, our results suggest that people with schizophrenia and co-occurring cannabis dependence have a unique pattern of risk-taking that is, in some ways, intermediate between the patterns found in those with each condition alone. On self-report measures, the co-morbid participants are similar to those with schizophrenia alone in ratings of self-mastery, to those with cannabis dependence alone in sensation-seeking, and similar to both illness groups in impulsivity. Their laboratory behavior is most similar to people with cannabis dependence only or healthy controls, rather than to people with schizophrenia alone. These findings offer some support for the notion that people with schizophrenia and co-occurring cannabis dependence are self-selected for higher functioning. They may have more social contacts influencing their drug use and/or have the necessary level of function to procure cannabis consistently compared to those with schizophrenia without regular cannabis use (Rabin et al., 2011).

This study has several strengths. We assessed both self-report and a behavioral measure of risk-taking, using a variety of validated instruments. None of the self-report risk instruments contained potentially biasing items about drug use. We also tested four distinct groups, including positive (cannabis dependence only, schizophrenia only) and negative (healthy volunteers) control groups. Finally, our cannabis-using groups had current cannabis dependence, not merely recreational use, and only one participant had another current substance use disorder other than tobacco.

There are several limitations to this study. First, age, gender, and education differences among the four groups could have influenced the dependent variables and could not be statistically controlled in these small samples. However, recent studies using the BART have not demonstrated large effects of gender or age on this test. A neuroimaging study examining gender differences on the BART found no male-female differences on the mean number of balloon trials where money was earned or where no money was earned (Cazzell et al., 2012). The number of pumps in trials where money was earned was analyzed separately from the number of pumps in trials with a balloon explosion and males pumped significantly more times in trials leading to an explosion. The amount of money won by males versus females was not reported. Likewise, a study of age effects on modified high-risk and low-risk BARTs (differing on probabilities balloons would explode with each pump) found no differences in older (mean age 73 yo) versus younger (mean age 21 yo)

groups on mean number of pumps or in amount of money earned (Cavanagh et al., 2012). A more detailed analysis where performance was subdivided into four blocks of ten trials each found that the older group made significantly more pumps in blocks 3 and 4 during the high-risk BART than the younger group. Second, we lacked complete information on participants' antipsychotic treatment. Some, but not all (Strous et al., 2006), studies evaluating the effect of antipsychotic medication on impulsivity in patients with schizophrenia found a greater reduction in impulsivity with clozapine than with first generation or other second generation antipsychotics (Dursan et al., 2000; Spivak et al., 1997; Spivak et al., 2003). Thus, a differential distribution of clozapine treatment between the two schizophrenia groups could have biased our findings. Third, lifetime cannabis use was not quantified and control groups had prior exposure to cannabis. Therefore, the achieved distinction between cannabis-using and non-using groups may not have been as great as intended.

In conclusion, people with schizophrenia and cannabis dependence may represent a distinct population within the illness. This knowledge could guide interventions targeted at behavioral change in this population. For example, lower ratings of self-mastery compared to healthy controls indicate that more effort might be required to convince people with co-occurring disorders that they can effect change through behavior modification. At the same time, if this group does not have the difficulty integrating reward value into decisions that is seen in people with schizophrenia alone, it may be easier to implement techniques like contingency management. Future work should examine other laboratory-based decision-making tasks, such as the Iowa Gambling Task (Bechara et al., 1994), and changes in behavior made in response to interventions such as motivational interviewing.

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Table 1

Baseline Demographic Characteristics, Psychological Symptoms, and Cognition among 89 Study Participants

	Schizophrenia (Sz) n=24	Schizophrenia & Cannabis Dependence (SzCb) n=18	Cannabis Dependence (Cb) n=23	Healthy Controls (HC) n=24	Test for Significance (df)	p-Value
Age, Years [Mean (SD)][a]	40.75 (12.47)	30.72 (8.17)	27.35 (8.19)	29.21 (11.86)	F(3,85)=7.66	0.0001
Male Gender [n (%)]	20 (83.3)	17 (95.5)	16 (69.6)	12 (50)	$X^2(3)=12.08$	0.007
Non-White [n (%)]	10 (41.7)	15 (83.3)	3 (13.0)	6 (25.0)	$X^2(3)=6.02$	0.11
Education, Years [Mean (SD)][b]	12.33 (2.28)	11.06 (1.86)	12.18 (1.53)	13.48 (1.59)	F(3,83)=5.86	0.001
Symptoms						
BPRS Total [Mean (SD)]	31.11 (7.93)	29.71 (8.35)	-	-	$X^2(1)=0.49$	0.48
BPRS Psychosis Subscale [Mean (SD)]	7.61 (3.85)	7.63 (3.31)	-	-	$X^2(1)=-0.03$	0.86
Cognition						
RBANS [Mean (SD)][c]	378.88 (53.28)	365.50 (91.61	398.30 (91.54)	447.83 (34.03)	$X^2(3)= 26.27$	0.00001
WTAR [Mean (SD)][d]	94.50 (18.27)	90.00 (18.12)	91.48 (18.53)	105.96 (18.12)	F(3,85)=3.55	0.02

BPRS= Brief Psychiatric Rating Scale; RBANS= Repeatable Battery for the Assessment of Neuropsychological Status; SUMD= Scale to Assess Unawareness of Mental Disorder; WTAR= Wechsler Test of Adult Reading

[a] Sz group was older than SzCb ($t_{85}=-3.05$, p=0.003), Cb ($t_{85}=-4.36$, p<0.0001), and HC ($t_{85}=3.80$, p=0.0003) groups.

[b] HC group was more educated than Sz ($t_{83}=-2.12$, p=0.04), SzCb ($t_{83}=-4.17$, p<0.0001), and Cb ($t_{83}=-2.35$, p=0.02) groups.

[c] Repeatable Battery for the Assessment of Neuropsychological Status score was significantly higher in HC compared to Sz ($X^2=20.12$, p=0.00001), SzCb ($X^2=17.38$, p=0.00001), and Cb ($X^2=7.19$, p=0.007) groups.

[d] Wechsler Test of Adult Reading score was significantly higher in HC compared to Sz ($t_{85}=-2.17$, p=0.03), SzCb ($t_{85}=-2.80$, p=0.006), and Cb ($t_{85}=-2.72$, p=0.008) groups.

Table 2

Substance Use Characteristics of 89 Study Participants

	Schizophrenia (Sz) n=24	Schizophrenia & Cannabis Dependence (SzCb) n=18	Cannabis Dependence (Cb) n=23	Healthy Controls (HC) n=24	Test for Significance (df)	p-Value
Expired CO Level [a] (ppm)	19.54 (20.27)	11.44 (7.96)	15.30 (11.27)	5.21 (8.26)	$X^2(3)=20.39$	0.0001
Alcohol Use 14 days[b] **prior to screening** [n (%)]	6 (25)	14 (77.8)	19 (82.6)	9 (39.1)	$X^2(3)=21.88$	<0.0001
Urine Toxicology						
Positive Cannabis [n (%)]	0	16 (89.0)	22 (95.7)	0	$X^2(3)=73.07$	0.0001
Positive Cocaine [n (%)]	0	1 (5.6)	0	0	$X^2(3)=3.99$	0.20
Positive Amphetamine [n (%)]	0	0	0	0	0	--
Positive Opiate [n (%)]	0	1 (5.6)	1 (4.4)	0	$X^2(3)=2.46$	0.35
Lifetime Experience[b]						
Ever Smoked Cigarettes [n (%)]	24 (100)	18 (100)	20 (87.0)	13 (54.2)	$X^2(3)=24.37$	<0.0001
Ever Used Cannabis [n (%)]	22 (91.7)	18 (100)	23 (100)	12 (50.0)	$X^2(3)=29.91$	<0.0001
Ever Used Cocaine [n (%)]	11 (45.8)	4 (22.2)	2 (8.7)	6 (25.0)	$X^2(3)=8.67$	0.03
Ever Used Amphetamines [n (%)]	9 (37.5)	5 (27.8)	12 (52.2)	2 (8.3)	$X^2(3)=11.05$	0.01
Ever Used Heroin [n (%)]	3 (12.5)	3 (16.7)	1 (4.4)	2 (8.3)	$X^2(3)=1.93$	0.59

CO= Carbon Monoxide

[a] Expired carbon monoxide was significantly lower in HC group as compared to Sz ($X^2=12.33$, p=0.0004), Cb ($X^2=14.51$, p=0.0001), and SzCb ($X^2=10.75$, p=0.001) groups.

[b] Based on answers to the Drug and Alcohol Use Survey.

Table 3

Insight, Self-Mastery, Optimism, Risk Perception and Risk-Taking/Impulsivity among 89 Adults with Schizophrenia and/or Cannabis Dependence and Healthy Controls

	Schizophrenia (Sz) n=24	Schizophrenia & Cannabis Dependence (SzCb) n=18	Cannabis Dependence (Cb) n=23	Healthy Controls (HC) n=24	Test for Significance (df)	p-Value
Insight						
SUMD General [Mean (SD)]	1.67 (1.13)	1.60 (0.98)	-	-	$X^2(1)=0.01$	0. 94
SUMD Symptoms [Mean (SD)]	2.62 (1.02)	2.53 (1.21)	-	-	$X^2(1)=0.01$	0.91
Self-Mastery						
Self-Mastery Scale [Mean (SD)][a]	19.96 (4.9)	22.11 (4.19)	23.26 (3.00)	24.78 (2.71)	F(3,83)=6.63	0.0005
Optimism						
LOT-R [Mean (SD)]	21.04 (4.91)	20.67 (4.28)	20.70 (4.13)	22.92 (3.35)	F(3,85)=1.50	0.22
Risk Perception						
Risk Perception Questionnaire [Mean (SD)]	-38.21 (48.46)	-56.44 (49.56)	-58.39 (38.37)	-57.50 (38.63)	$X^2(3)=2.30$	0.51
Cherpitel Risk Perception [Mean (SD)]	19.67 (7.82)	17.33 (6.76)	21.39 (7.23)	22.00 (6.23)	$X^2(3)=5.21$	0.16
Reported Risk-Taking: Impulsivity						
ZKPQ-Imp [Mean (SD)][b]	3.79 (2.11)	3.39 (1.82)	3.17 (1.72)	1.92 (1.28)	F(3,85)=5.03	0.003
Cherpitel Risk- Taking/Impulsivity [Mean (SD)]	10.63 (3.80)	10.83 (3.26)	11.22 (3.79)	9.38 (3.29)	F(3,85)=1.17	0.33
Reported Risk-Taking: Sensation-Seeking						
ZKPQ-SS [Mean (SD)]	4.71 (3.37)	5.17 (3.01)	6.04 (2.93)	3.63 (2.84)	$X^2(3)=6.96$	0.07
Cherpitel Sensation- Seeking [Mean (SD)[c]]	11.00 (3.80)	11.94 (3.62)	13.17 (3.08)	10.46 (2.98)	$X^2(3)=7.94$	0.05
Risk-Taking Behavior[d]						
BART: Pumps [Mean (SD)][e]	28.80 (12.22)	35.41 (12.51)	39.57 (7.67)	35.57 (9.27)	$X^2(3)=10.22$	0.02
BART: Explosions [Mean (SD)][f]	6.46 (3.67)	9.56 (4.27)	11.52 (3.76)	9.23 (4.71)	F(3,79)=5.82	0.001
BART: Money Earned [Mean (SD)]	13.39 (5.00)	14.89 (3.91)	15.23 (1.64)	15.10 (2.35)	$X^2(3)=1.15$	0.77

BART= Balloon Analog Risk Task; LOT-R= Revised Life Orientation Test; ZKPQ-Imp= Zuckerman-Kuhlman Personality Questionnaire- Impulsivity; ZKPQ-SS= Zuckerman-Kuhlman Personality Questionnaire- Sensation-Seeking

[a] Self-Mastery was significantly higher in HC compared to Sz (t_{85}=-4.33, p<0.0001) and SzCb (t_{85}=-2.24, p=0.03) groups; Cb was significantly higher than Sz group (t_{85}=2.96, p=0.004).

[b] ZKPQ-Imp was significantly lower in HC compared to Sz (t_{85}=-3.70, p=0.0004), SzCb (t_{85}=2.69, p=0.009), and Cb (t_{85}=2.46, p=0.02) groups.

[c] Sensation-seeking measured by Cherpitel's questions was significantly higher in Cb compared to HC (X^2=8.76, p=0.003) and trended higher compared to Sz (X^2=3.23, p=0.07) group.

[d] Sz group n=24; SzCb group n=16; Cb group n=21; HC group n=22.

[e] BART Balloon Pumps were significantly lower in Sz compared to Cb (X^2=9.65, p=0.002) and trended lower compared to SzCb (X^2=3.42, p=0.06) and HC (X^2=3.10, p=0.08) groups. (t_{79}=-2.18, p=0.03) groups.

[f] BART Balloon Explosions were significantly lower in Sz compared to SzCb (t_{79}=2.34, p=0.02), Cb (t_{79}=4.13, p=0.0001), and HC (t_{79}=-2.28, p=0.03) groups.