Brief report: The impact of alcohol and cannabis misuse on cognition among individuals with schizophrenia

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Substance misuse and cognitive deficits both impede the treatment and recovery of persons with schizophrenia (Buckley et al., 2009; Green et al., 2004a). Studies show that cognitive performance is one to two standard deviations below average in schizophrenia (Dickinson et al., 2003; Gold, 2004) and that such deficits span neurocognitive and social–cognitive domains (Nuechterlein et al., 2004), lead to poor long-term outcomes (Green et al., 2004a), and may become worsened when those with the disorder misuse substances (Potvin et al., 2012). However, while alcohol and cannabis misuse has been associated with poorer cognitive outcomes in schizophrenia have yielded mixed results (Potvin et al., 2012).

Studies of the cognitive impact of alcohol or cannabis misuse in schizophrenia have yielded mixed results (Potvin et al., 2012). Cannabis-misusing schizophrenia patients tend to demonstrate better cognitive performance than their non-cannabis-misusing counterparts (Coulston et al., 2007; DeRosse et al., 2010; Jockers-Scherübl et al., 2007; Leberg &Hughdahl, 2009; Rabin et al., 2011; Rodriguez-Sanchez et al., 2010; Sevy et al., 2001; Yücel et al., 2012), yet a few studies have reported no between-group differences (Bahorik et al., 2014; Mata et al., 2008; Scholes & Martin-Iverson, 2010). In contrast, alcohol-misusing schizophrenia patients exhibit worse cognitive performance than their non-alcohol-misusing counterparts (Allen &Remy, 2001; Bowie et al., 2005; Manning et al., 2009; Mohamed et al., 2006; Thoma et al., 2006), with a few studies reporting no between-group differences (Addington &Addington, 1997; Allen et al., 2000; Nixon et al., 1996).

Regarding the mixed findings reported between substance misuse and non-misusing schizophrenia patients on cognitive outcomes, several questions about the way in which the severity associated with alcohol, cannabis, or the concurrent use of these substances impacts cognition among those seeking treatment to improve these deficits remain. Variability in the degree of severity, which has been defined within the context of the problems that necessitate substance use treatment (McLellan et al., 1980), may reveal important cognitive differences within this subgroup. To date, however, the way in which such misuse impacts cognition in substance-misusing schizophrenia (SMS) has remained largely unexamined. The objectives of this study were to investigate cognitive performance differences between SMS, schizophrenia, and control participants, and examine whether alcohol or cannabis severity impacts cognition within the SMS sample.

Participants included 32 SMS, 28 schizophrenia, and 37 control participants partaking in studies of Cognitive Enhancement Therapy (CET [Hogarty and Greenwald, 2006]) at the University of Pittsburgh. Inclusion criteria for schizophrenia outpatients consisted of an IQ ≥ 80; age 18 to 60; antipsychotic medication adherent; and schizophrenia/schizoaffective disorder confirmed by the Structured Clinical Interview for DSM-IV (SCID [First et al., 2000]). Inclusion criteria for SMS outpatients consisted of these criteria, as well as Addiction Severity Index (ASI [McLellan et al., 1980]) severity ratings ≥ 4 for alcohol or cannabis, and significant cognitive and social disability confirmed by the Cognitive Styles and Social Cognition Eligibility Interview (Hogarty and Greenwald, 2006). Cognitive and social disability criteria were part of the inclusion criteria for SMS patients to ensure that such participants had sufficient disability to need treatment. Inclusion criteria for controls consisted of an age 18 to 50; free from psychiatric diagnosis per the SCID; no substance abuse within 3 months. Participants’ characteristics are presented in Table 1.

The Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS [Green et al., 2004b]) Consensus Cognitive Battery assessed neurocognition. This battery assesses processing speed, verbal/non-verbal working memory, attention/vigilance, verbal/visual learning, and problem solving.

The Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT [Mayer et al., 2003]) and the Penn Emotion Recognition Test (Kohler et al., 2000) assessed social cognition. The MSCEIT consists of 141-items, is scored using consensus norms with a mean (SD) of 100 (15), and has been validated in normative (Mayer et al., 2003) and psychiatric samples (Eack et al., 2010). The Penn Emotion Recognition Test (Kohler et al., 2000) assessed facial emotion perception.

The 35-item substance use scale of the ASI (McLellan et al., 1980) assessed substance misuse and severity. SMS patients were asked about current (total days within 30 days) and lifetime (total years) alcohol and cannabis use. Severity was rated on a 0 to 10 point scale and
Consisted of the rater’s impression of the patient’s problem use and the patient’s impression of their treatment need; higher scores signaled both greater severity and treatment need. ASI cut-points (McLellan et al., 1980) were used to distinguish clinically meaningful subgroups of SMS patients with moderate (scores, 4–5) or high (scores, 6–9) severity for post-hoc analyses.

Participants were recruited from the Pittsburgh area. Diagnostic interviews were carried out by staff using the SCID supervised by diagnosing technicians. Staff using the ASI carried out severity assessments; SMS patients with ratings ≥ 4 were enrolled. After determining eligibility, testes administered cognitive measures to participants. Pretreatment data were analyzed for patients partaking in CET studies. This research was approved and reviewed annually by the University of Pittsburgh Institutional Review Board. Participants provided written informed consent.

Comparisons of overall performance differences on domain measures of neurocognition and social cognition between control, SMS, and schizophrenia participants adjusting for sex, age, race, and IQ revealed significant differences in neurocognitive function across the domains measured (all \( p < .027 \)), and in emotion accuracy, emotion understanding, and total emotional intelligence social–cognitive function (all \( p < .013 \)). Planned follow-up pairwise comparisons showed that schizophrenia and SMS participants had marked impairment in these domains of cognitive function compared to controls. Few differences in neurocognitive performance were observed between schizophrenia and SMS participants, and no differences in social–cognitive performance were observed. Attention/vigilance was the only domain with SMS participants demonstrating superior cognitive performance compared to those with schizophrenia (Table 2).

Subsequent analyses were then conducted to examine overall performance differences on the domain measures of neurocognition and social cognition between SMS patients with high (score, 6–9) or moderate (score, 4–5) alcohol or cannabis severity. The proportion of patients comprising these severity groups is presented in Table 1. Results revealed moderate alcohol severity patients (\( M = 33.88; SE = 5.35 \)) had better reasoning neurocognitive function than those (\( M = 13.49; SE = 2.24 \)) with high alcohol severity (\( p < .001 \)). However, high alcohol severity patients (\( M = 35.48; SE = 1.08 \)) exhibited better emotion perception than those with (\( M = 30.68; SE = 0.91 \)) moderate alcohol severity (\( p < .001 \)). High alcohol severity (\( M = 101.43; SE = 2.42 \)) patients also had better emotion management than those with moderate alcohol (\( M = 84.85; SE = 1.91 \)) severity (\( p < .001 \)). No between-group differences were observed among high or moderate cannabis severity patients (all \( p > .231 \)) patients. Patient’s not using cannabis within 30 days of enrollment had better emotion processing, attention/vigilance, and processing speed compared to non-cannabis users within 30 days (all \( p < .039 \)). No differences were observed between alcohol users or non-users within 30 days of enrollment (all \( p > .173 \)).

Prior studies examining the impact of substance misuse on cognition in schizophrenia have varied (Potvin et al., 2012). Since such studies have not adequately addressed the severity associated with misusing substances, a more extensive examination of these effects is warranted. We found few differences between SMS and schizophrenia patients, indicating similar degrees of cognitive impairment. Further, recent cannabis, but not alcohol use had a negative impact on various cognitive domains. Interestingly, moderate alcohol severity patients had worse emotion processing than high alcohol severity patients.

Limitations and implications of this research should be noted. Our modest sample limits generalizability, with additional limitations including a lack of statistical control for chronicity of substance misuse and schizophrenia, the absence of biomedical testing, and the lack of sample representativeness. Despite such limitations, our results have implications for future research. Prior research reports cognitive advantages for SMS (alcohol/cannabis) over schizophrenia patients in terms of processing speed (Herman, 2004; McCleery et al., 2006; Potvin et al., 2005; Thoma et al., 2007), but we observed that schizophrenia patients had better processing speed than SMS patients. Of the studies reporting improved processing speed in SMS patients, McCleery et al. (2006) studied first–episode patients, Herman (2004) studied inpatients, and both Potvin et al. (2005) and Thoma et al. (2007) included polysubstance misusers in their samples. We used an outpatient sample and did not focus on first–episode patients or substances other than alcohol/cannabis, which may account for differences in our findings. Aside from finding better attention/vigilance in SMS patients, no other between–group differences were observed, which is consistent with comparative studies (Barnes et al., 2006; Harrison et al., 2008; Pencer et al., 2000).
Table 2
Neurocognitive and social–cognitive test performance of healthy individuals, and participants with schizophrenia-spectrum disorders with and without substance misuse problems (N = 97).

| Variable                          | HC N = 37 | SMS N = 32 | SZ N = 28 | Analysis |
|-----------------------------------|-----------|------------|-----------|----------|
|                                   | M         | SE         | M         | SE       |
| Neurocognition Domain             |           |            |           |          |
| MCCB                              |           |            |           |          |
| Processing Speed                  | 78.78     | 4.01       | 24.17     | 4.82     | 41.11     | 5.85     | 37.88     | 2       | < .001 | HC > SZ > SMS |
| Attention/Vigilance               | 53.46     | 4.99       | 31.13     | 5.23     | 16.00     | 3.47     | 20.80     | 2       | < .001 | HC > SMS > SZ |
| Working Memory                    | 53.68     | 5.03       | 31.83     | 5.89     | 30.11     | 4.93     | 6.81      | 2       | < .001 | HC > SMS, SZ |
| Verbal Learning                   | 53.25     | 4.89       | 19.76     | 4.54     | 32.87     | 6.20     | 11.85     | 2       | < .001 | HC > SMS, SZ |
| Reasoning/Problem Solving         | 56.22     | 4.78       | 36.00     | 4.99     | 40.55     | 6.35     | 3.76      | 2       | .027   | HC > SMS |
| Visual Learning                   | 60.62     | 4.38       | 34.48     | 5.35     | 25.44     | 5.73     | 14.36     | 2       | < .001 | HC > SMS, SZ |
| Social Cognition Domain           |           |            |           |          |
| MSCEITc                           |           |            |           |          |
| Total Score                       | 100.78    | 2.30       | 92.12     | 2.38     | 91.02     | 2.50     | 5.18      | 2       | .007   | HC > SMS, SZ |
| Emotion Perception                | 102.62    | 2.89       | 98.64     | 4.17     | 94.79     | 3.07     | 1.89      | 2       | .156   | – |
| Emotion Facilitation              | 102.37    | 2.27       | 97.33     | 3.49     | 97.05     | 2.78     | 1.15      | 2       | .319   | – |
| Emotion Understanding             | 102.42    | 1.85       | 89.24     | 2.02     | 89.00     | 2.29     | 15.35     | 2       | .001   | HC > SMS, SZ |
| Emotion Management                | 95.19     | 1.96       | 90.61     | 2.28     | 91.78     | 1.86     | 1.32      | 2       | .271   | – |
| Penn Emotion Recognition Test     |           |            |           |          |
| Accuracy                          | 34.52     | 0.53       | 32.27     | 0.87     | 32.06     | 0.78     | 4.56      | 2       | .013   | HC > SZ |
| Reaction Time (log)               | 7.57      | 0.34       | 7.71      | 0.06     | 7.66      | 0.04     | 2.22      | 2       | .115   | – |

Note. HC = Healthy controls; SMS = substance misusing schizophrenia patients (alcohol or cannabis); SZ = patients with schizophrenia. Performance differences between study groups were investigated by using linear mixed-effects models, which were carried out utilizing R version 2.15.0 (R Development Core Team, 2014). The means account for age, sex, race, and IQ differences. Neurocognitive and social–cognitive domain scores were standardized by scaling test items to a common (z) metric. Higher scores indicate better neurocognitive or social cognitive functioning.

The statistical significance of all pairwise comparisons are adjusted using Hochberg’s (1988) correction.

The authors report no conflicts of interest.

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Contributors
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