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Impaired insight in concurrent disorders: identifying patterns in drug seeking behaviours

Tanisse Epp[1], Karling R. Luciani[1,3], Alyssa Turcott[1], Keenan Klassen[1], Christian G. Schütz[1,2,4*]

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[1]Institute of Mental Health, Department of Psychiatry, University of British Columbia, BC, Canada
[2]British Columbia Mental Health and Substance Use Services Research Institute, Provincial Health Services Authority, BC, Canada
[2]ORCiD: 0000-0002-1454-2535
[4]ORCiD: 0000-0002-5445-8290
*Corresponding author: Christian G. Schütz: christian.schutz@ubc.ca

Abstract. *Background:* Concurrent disorders involve overlapping mental health and substance use disorders, often associated with impaired insight, affecting treatment adherence and behavioural control. Previous studies have utilized self-report measures of insight; however, objective assessments in this population are scarce. *Methods*: This study recruited 53 inpatients with concurrent disorders (41 with a stimulant use disorder, 12 with other substance use disorders) from the Red Fish Healing Centre for Mental Health and Addiction and 38 controls (no history of substance use disorder or mental health disorder). Participant's insight was assessed using a probabilistic picture choice task and a self-report measure. Cognitive functions such as premorbid functioning, working memory, and pattern comparison were evaluated. Analyses included logistic regression and ANOVAs. *Results:* No significant differences in insight were noted between groups after controlling for working memory. Individuals with stimulant-specific disorders exhibited a preference for stimulant images over pleasant images, indicating an attentional bias. There was no significant correlation between self-report and behavioural insight measures, nor were there significant changes in insight over time. *Conclusion:* This study provides new insights into the interplay between cognitive deficits, attentional biases, and insight in individuals with concurrent disorders, underlining the challenges in measuring and improving insight within this group. *Implications:* The findings highlight the significant role of working memory in measuring insight. The persistent attentional bias toward stimulant cues in those with stimulant-specific disorders suggests the need for targeted interventions that address cognitive impairments. Future research should consider developing alternative insight assessment tools that are less dependent on the cognitive capacity to evaluate this population more effectively.

Keywords: Drug Seeking, Concurrent Disorders, Impaired Insight, Treatment.

Introduction

Concurrent disorders are the co-occurring diagnoses of mental health and substance use disorder. Approximately 25% of individuals with an anxiety disorder or major depressive disorder will have an overlapping substance use disorder in their lives. In comparison, 50% of individuals with bipolar disorder or schizophrenia will have a co-occurring substance use disorder (Khan, 2017). Furthermore, concurrent disorders are more common in treatment populations (Sliedrecht et al., 2019). They are associated with a higher risk for substance relapse, re-hospitalizations, and mortality when compared to individuals with a singular disorder diagnosis (Sliedrecht et al., 2019). The severity of mental health disorders appears to elevate the risk of developing substance use disorders and vice versa (Kavanagh et al., 2004). Research is increasingly exploring the complex interactions and common etiologies of these disorders. Currently, our understanding of concurrent disorders assumes overlapping yet separate disorder entities. A feature that has been identified as a critical player in health outcomes of both substance use and mental health is impaired insight (Moeller et al., 2010; Orfei et al., 2010).

Impaired insight within substance use disorders and mental health disorders can be characterized by the failure to recognize the presence, severity, and development of social impairments and the impact of substance use on decision-making and compromised control of action (Moeller et al., 2010). Impaired insight has observed effects on drug-seeking behaviours, behavioural control, and treatment outcomes, suggesting motivational processes may occur outside of someone's awareness (Goldstein et al., 2009). For instance, greater insight for those with substance use disorders is associated with better treatment adherence and maintaining abstinence (Raftery et al., 2020). Additionally, individuals with cocaine use disorder and impaired insight have more difficulties maintaining motivation during treatment (Castine et al., 2019) and have more severe cocaine use (Moeller et al., 2010).

Within mental health disorders, clinically assessed impaired insight has been investigated in treatment outcomes (Belvederi Murri et al., 2016; Lysaker et al., 2022). For those with schizophrenia, impaired insight predicts poorer treatment adherence, therapeutic alliance, and higher symptom severity (Lysaker et al., 2018). Other studies suggest that having greater insight may increase the likelihood of cultural and self-stigmatization, making an individual less inclined to access treatment (Belvederi Murri et al., 2016). These contrasting results highlight discrepancies in conceptualizing and operationalizing insight across studies and the need for consistent and accurate measures.

So far, insight has been measured using self-reported questionnaires; a more objective behavioural measure is needed to overcome the apparent limitations of self-report measures (Goldstein et al., 2007; Moeller et al., 2010). Moeller et al. (2010) developed an objective

behavioural measure of insight using a probabilistic choice task, which was validated in a population of individuals with cocaine and methamphetamine use disorders. We utilize this probabilistic choice task in tandem with self-report measures to assess insight among inpatients with concurrent disorders compared to controls. To our understanding, this study is the first to evaluate insight within individuals with concurrent disorders. As such, our main research question is that individuals with a co-occurring stimulant use disorder and a diagnosis of a mental health disorder (stimulant-specific concurrent disorders) will show impaired insight into their stimulant use disorders. Given the lack of any previous research into the concurrent disorder population, we will further explore the following questions: whether individuals with stimulant-specific concurrent disorders will show a greater preference for stimulant-related pictures over other choices; whether there will be a lack of correlation between self-report questionnaires and the behavioural task; and whether insight will change over time.

Materials and Methods

Participants

The sample comprises 53 individuals with concurrent disorders who were inpatients at the Red Fish Healing Centre for Mental Health and Addiction in Coquitlam, British Columbia, Canada and were diagnosed with a co-occurring mental health disorder and substance use disorder based on the international classifications and versions used to diagnose SUDs and mental disorders (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition or International Classification of Diseases-11). Of this sub-sample, 41 individuals had a stimulant use disorder and a co-occurring mental health disorder, and 12 individuals had a substance use disorder (other than stimulant use disorder) and a co-occurring mental health disorder. Inclusion and exclusion criteria included understanding the purpose of the study, being 19 years or older, could speak and read in English, deemed safe to participate by the Patient Care Committee (i.e., they were currently stable in the facility and not at risk for violence), and would not be discharged within one month of enrollment. The inpatient sample was recruited by approaching eligible inpatients, as deemed by the Patient Care Committee or through word-of-mouth between inpatients.

The sample also includes 38 controls with no current mental health or substance use disorder diagnoses, as identified through the Mini-International Neuropsychiatric Interview (Sheehan et al., 1998) administered by a trained research assistant. Control participants were community volunteers recruited virtually through social media (Twitter and Instagram) posts, the University of British Columbia website postings, and Craigslist. Inclusion and exclusion criteria to deem controls eligible for participation were: 1) no history of head trauma (assessed using the Ohio State University TBI Identification Method; Corrigan & Bogner, 2007), and 2) no current diagnosis of a mental health or substance use disorder.

Table 1 presents demographic information for all participants, split by group. Ethical approval was obtained from the University of British Columbia Clinical Research Ethics Board (H21-01451), the Red Fish Healing Centre for Mental Health and Addiction Research Committee, and the Data Access Committee.

Table 1. Demographic, cognitive, and substance use characteristics by study group.

	Stimulant-Specific Concurrent Disorder (n = 41)			Non-Stimulant Concurrent Disorder (n = 12)			Control (n = 38)			
	M	**SD**	**n (%)**	**M**	**SD**	**n (%)**	**M**	**SD**	**n (%)**	**P-value**
Age (years)	33.0	12.8	-	31.3	12.3	-	28.3	13.8	-	.003
Gender										.26
Male	-	-	20 (48.8%)	-	-	4 (33.3%)	-	-	12 (31.6%)	
Female	-	-	21 (51.2%)	-	-	8 (66.7%)	-	-	26 (47.3%)	
Test of Premorbid Functioning	35.3	12.9	-	30.9	12.3	-	45.7	14.8	-	.001
NIH Toolbox Working Memory[a]	81.0	12.3	-	80.1	11.5	-	102.5	14.9	-	< .001
NIH Toolbox Pattern Comparison	90.5	21.3	-	101.2	28.0	-	110.7	22.0	-	.001

[a]age-corrected

Measures

Insight Measures

The probabilistic picture choice task has been previously validated across those who use cocaine and methamphetamine (Moeller et al., 2010) and is designed to measure stimulant use disorder-related insight. Detailed descriptions of the instructions for the task can be found in Moeller et al. (2010). One hundred and twenty coloured pictures (30 blank, 30 neutral, 30 pleasant, and 30 stimulant-related) served as stimuli, selected from the International Affective Picture System (Lang et al., 1997). Stimulant-related pictures were derived from previous tasks and included a variety of stimulant-related pictures such as pills, crystals, different types of powder and different modes of consumption (Dunning et al., 2011; Moeller et al., 2012; Parvaz et al., 2017). The task asks participants to select the deck of pictures that they want to see more of. Participants are made aware that there

are no right or wrong answers. Participants who show correspondence between their subjective and objective picture choices are classified as having intact insight. Those who do not show correspondence between subjective and objective picture choices are classified as having impaired insight. This behavioural measure was assessed in all participants.

The Substance Use Awareness And Insight Scale (SAS) assesses subjective illness awareness in individuals with substance use disorder (Kim et al., 2022). This seven-item measure addresses general illness awareness, symptom attribution, awareness of the need for treatment, and awareness of negative consequences. An average total score was derived from these items. This self-report measure was only assessed in participants with concurrent disorders (Table 2).

Table 2. Time in treatment and diagnoses across stimulant-specific concurrent disorder and non-stimulant concurrent disorder.

	Stimulant-Specific Concurrent Disorder (n = 41)			Non-Stimulant Concurrent Disorder (n = 12)			
	M	**SD**	**n (%)**	**M**	**SD**	**n (%)**	**P-value**
Days in Treatment at Baseline	54.2	50.2	-	-	-	-	.21
Psychotic Spectrum Diagnosis	-	-	36 (83.7%)	-	-	4 (57.1%)	.13
Mood Disorder Diagnosis	-	-	15 (34.9%)	-	-	5 (71.4%)	.10
Personality Disorder Diagnosis	-	-	15 (34.9%)	-	-	3 (42.9%)	.69
Anxiety and Stress Disorder Diagnosis	-	-	17 (39.5%)	-	-	4 (57.1%)	.43
Alcohol Use Disorder Diagnosis	-	-	15 (34.9%)	-	-	3 (42.9%)	.69
Stimulant Use Disorder Diagnosis	-	-	41 (100%)	-	-	0 (0%)	<.001
Opioid Use Disorder Diagnosis	-	-	29 (67.4%)	-	-	1 (14.3%)	.01
Cannabis Use Disorder Diagnosis	-	-	23 (53.5%)	-	-	3 (42.9%)	.70
Tobacco Use Disorder Diagnosis	-	-	18 (41.9%)	-	-	2 (28.6%)	.69

Cognitive Measures

The Test for Premorbid Functioning (TOPF) was developed to predict memory and intellectual performance (Reale-Caldwell et al., 2021; Wechsler, 2001, 2009). It is composed of 70 words that have irregular English pronunciations (Wechsler, 2009), and the number of correct pronunciations is scored.

The NIH-Toolbox List Sorting Working Memory Test (Weintraub et al., 2013) is part of the NIH-Toolbox Cognitive Battery (Gershon et al., 2010) that acquires a measure of working memory. The task is to repeat the stimuli sequence verbally according to their size, calculating a total number of correct sequence repetitions. Within this study, the total score is age-corrected.

The NIH-Toolbox Pattern Comparison Processing Speed Test (Carlozzi et al., 2015) measures the construct of processing speed by assessing the amount of information that can be processed at one time. The task involves showing the participant a pair of stimuli side by side and asking if they are the same or not the same. Processing speed is measured by the number of items they answered correctly. All cognitive measures were assessed with all participants (Table 1).

2.2.3 Treatment- and Medical-Related Measures for Inpatient Participants

Diagnosis for inpatient participants was obtained through medical charts, as evident in Table 2. Given the complexity and heterogeneity in diagnosing psychiatric disorders, this study used broad diagnosis categories within the analysis, including psychotic spectrum disorders (schizophrenia, schizoaffective disorder, psychotic disorder, and substance-induced psychotic disorder), mood disorders (depression, bipolar disorder, and substance-induced mood disorder), anxiety/stress-related disorders (generalized anxiety disorder, obsessive-compulsive disorder, and post-traumatic stress disorder), and neurodevelopmental disorders (fetal alcohol syndrome and attention-deficit hyperactivity disorder). Substance use disorders are characterized by the particular substance.

Inpatient participants' days in treatment at baseline were obtained by calculating the difference in the session date by the date of admission (Table 2).

Procedures

For the control group, once the participant had expressed interest, the research staff fully described the study, and written informed consent was obtained before initiating any study-related procedures. The control group was screened to ensure there was no history of substance use disorder and no history of psychiatric disorder using the Mini International Neuropsychiatric Interview Screener (Sheehan et al., 1998). History of head injury was also screened using the Ohio State University TBI Identification Method (Corrigan & Bogner, 2007). Control participants completed baseline assessments during the first session, including cognition assessments and demographics. The participant then completed the probabilistic choice task, which takes approximately five minutes. Approximately three months later, the control group completed the probabilistic choice task again.

For the concurrent disorders sample, after expressing interest in the study, research staff fully described the study and obtained written informed consent before initiating any study-related procedures. After written

consent was obtained, participants were screened for eligibility. At baseline, participants completed assessments for cognition and insight. Approximately three months after baseline assessments, the participants completed the probabilistic choice task and the self-report insight measure.

All participants received remuneration in the form of a $10 gift card following each session, regardless of completion.

Statistical Analysis

Statistical analyses were performed using SPSS for Mac 28.0.1.1 (SPSS Science, Chicago, Illinois, USA). Data was screened for missing data, outliers, normality, and homogeneity for each variable of interest. Outliers were brought into range. If normality was validated, transformations were conducted but only retained if it significantly changed the analysis outcome. If there was heterogeneity in variances, bootstrapped bias-corrected 95% confidence intervals and robust parameter estimates were used to compensate. Adjusted post-hoc comparisons were also integrated by analyzing the Games-Howell test for unequal variances.

Fisher's exact tests or one-way ANOVAs were used to identify group differences between demographics and cognitive variables. To determine within-group differences within the inpatient participants, Mann-Whitney U tests were used to analyze baseline days in treatment, and Fisher's exact test was used to analyze differences in diagnoses between the concurrent disorder groups.

To address our main research question, a multinominal logistic regression was used to compare the occurrence of impaired or intact insight between groups (stimulant-specific concurrent disorders, non-stimulant use disorder-specific concurrent disorders, and controls). For the first exploratory research question, two one-way ANOVAs were used to determine if stimulant-specific concurrent disorders showed a greater preference for stimulant-related pictures over neutral pictures and positive pictures compared to non-stimulant-specific concurrent disorders and controls. For the second exploratory research question, three Pearson correlations were used to identify the relationship between the SAS and the degree of insight obtained from the probabilistic choice task across groups. For the third exploratory research question, a Fisher's exact test was used to determine whether a change in insight occurred across groups from baseline to the second time point. A p-value of 0.05 was set for the level of statistical significance.

Results

Missing Data

At the second time point, 34 participants with concurrent disorders (56.7%) and 12 controls (30%) data were missing. Although, there was no significant relationship between baseline insight and missing data at the second time point ($p = .34$).

Participants

As described in Table 1, there was a significant difference in age between the groups ($F(2, 88) = 6.37$, $p = .003$), where the stimulant-specific

concurrent disorder group had a greater mean age compared to the control group (BCa 95% CI [-14.8, -3.9], $p = .002$). No significant differences were found in age between the non-stimulant concurrent disorder group and the control or the stimulant-specific concurrent disorder groups ($p > .5$). With regards to gender, there were no significant differences in male or female frequencies across groups ($p = .26$). For cognitive measures, all three measures were significantly different across groups (TOPF: $F(2, 81) = 7.47$, $p = .001$; Working Memory: $F(2, 77) = 25.63$, $p < .001$; Pattern Comparison: $F(2, 78) = 7.27$, $p = .001$). Post-hoc comparisons revealed that the TOPF showed significant differences between the control group and both concurrent disorder groups (stimulant: BCa 95% CI [3.4, 16.8], $p = .005$; non-stimulant: BCa 95% CI [5.8, 24.5], $p = .01$), where the controls had greater premorbid functioning. There were no significant differences between the concurrent disorder groups for premorbid functioning ($p = 1$). For working memory, post-hoc comparisons revealed significant differences between the control group and both concurrent disorder groups (stimulant: BCa 95% CI [15.0, 28.0], $p < .001$; non-stimulant: BCa 95% CI [13.3, 31.6], $p = .001$), where the controls had greater working memory. There were no significant differences between the concurrent disorder groups for working memory ($p = .98$). With regards to pattern comparison, post-hoc comparisons revealed only a significant difference between the control group and the stimulant-specific concurrent disorder group (BCa 95% CI [10.4, 30.7], $p < .001$), where the control group had significantly higher pattern comparison scores. However, no other significant differences were observed between the control and non-stimulant concurrent disorder groups ($p = .63$) or between the concurrent disorder groups ($p = .55$).

As described in Table 2, there were no significant differences in the concurrent disorder group's time in treatment at baseline ($p = .21$). Additionally, the only diagnostic difference between the groups was for stimulant use disorder ($p < .001$). All other diagnoses were not significantly different between the groups (all *p's*> .05).

3.3 Baseline Insight and Picture Choice

A logistic regression was performed to identify the effects of group (control, stimulant-specific concurrent disorder, and non-stimulant concurrent disorders) on the likelihood of impaired or intact insight. The first step initially added TOPF, working memory, and pattern comparison to the model. However, working memory was the only cognitive variable contributing to the model and remained at the first step of the final model to control for the effect of working memory on insight. The logistic regression model was statistically significant, $x^2(3, N = 1000) = 8.84$, $p = .03$. The model explained 15.3% (Nagelkerke R2) of the variance in insight and correctly classified 64.0% of cases. Larger working memory was more likely to have intact insight (B = .04, BCa 95%CI [.02, .08]), though after controlling for working memory, the participant groups were no longer associated with changes in insight (all *p's*> .05; see Table 3).

Table 3. Logistic regression identifying the effects of group (control, stimulant-specific concurrent disorder, and non-stimulant concurrent disorders) on the likelihood of impaired or intact insight, controlling for working memory.

		Bootstrapped	
Variable	**B**	**BCa 95% CI**	***p*-value**
Step One			
Working Memory	0.04	0.02, 0.08	.003
Step Two			
Working Memory	0.03	-0.01, 0.09	.08
Control Group	-2.28	-6.78, 4.84	.16
Stimulant-Specific Concurrent Disorder	0.14	-1.66, 14.23	.78
Non-Stimulant-Specific Concurrent Disorder	-0.37	-6.76, 0.41	.35

For the first exploratory research question, two one-way ANOVAs were performed to determine if stimulant-specific concurrent disorders will show a greater preference for stimulant-related pictures over neutral pictures and positive pictures compared to non-stimulant concurrent disorders and controls. The model was statistically significant for differences in choosing stimulant-related pictures over neutral pictures between groups, $F(2, 84) = 4.01$, $p = .02$. Post-hoc Games-Howell comparisons indicated a significant difference between control and non-stimulant concurrent disorder (BCa 95%CI [-14.2, -2.6], $p = .03$), where non-stimulant concurrent disorder chose more stimulant-related pictures than neutral pictures ($M = 2.42$, $SD = 9.17$) compared to controls ($M = -6.16$, $SD = 7.83$). There was no significant difference between control and stimulant-specific concurrent disorder ($M = -2.61$, $SD = 10.82$) or between the concurrent disorder groups themselves (all *p's*> .05; see Figure 1).

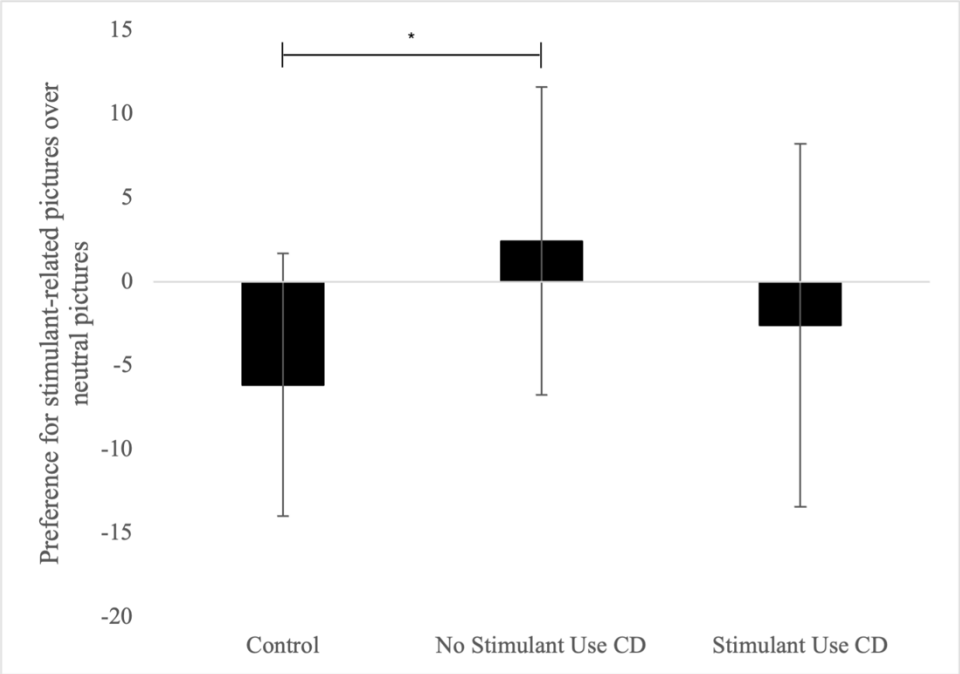

Figure 1. Mean differences in choosing stimulant-related pictures over neutral pictures across three groups: control, non-stimulant concurrent disorder (CD), and stimulant-specific CD. A significant difference between the control and non-stimulant CD group is evident with the non-stimulant CD group selecting more stimulant-related pictures than neutral pictures compared to controls. Asterisks (*) indicate significant differences less than .05.

For choosing stimulant-related pictures over positive pictures, the model was statistically significant, $F(2, 84) = 4.23$, $p = .02$. Post-hoc Games-Howell comparisons indicated a significant difference between control and stimulant-specific concurrent disorder (BCa 95%CI [-9.03, -2.00], $p = .008$), where those with stimulant-specific concurrent disorder choose more stimulant-related pictures over positive pictures ($M = -2.89$, $SD = 9.11$) compared to controls ($M = -8.46$, $SD = 6.32$). No significant difference was observed between controls and those with non-stimulant concurrent disorder ($M = -4.92$, $SD = 10.88$) or between the concurrent disorder groups themselves (all $p's > .05$; see Figure 2).

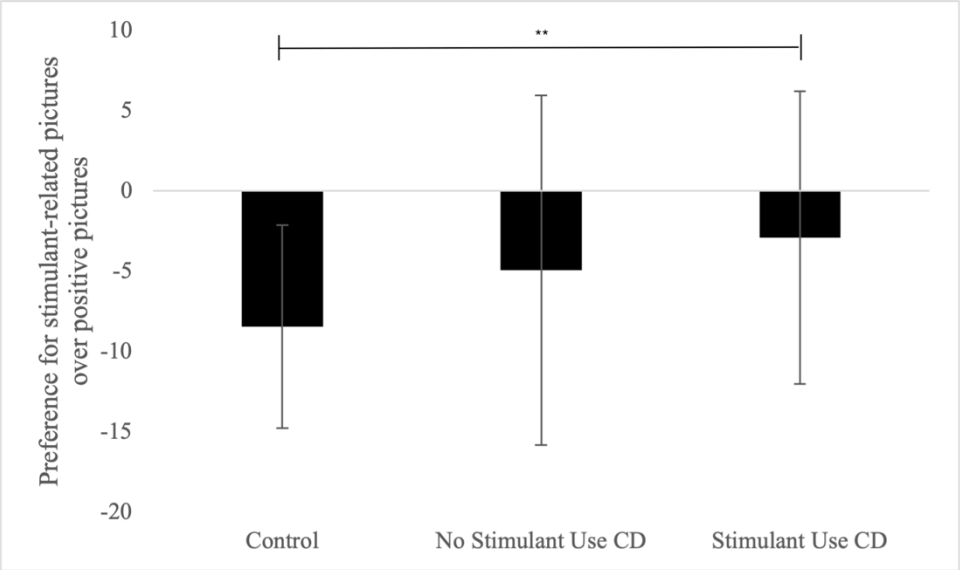

Figure 2. Mean differences in choosing stimulant-related pictures over positive pictures across three groups: control, non-stimulant concurrent disorder (CD), and stimulant-specific CD. A significant difference between the control and stimulant CD group is evident with the control group selecting more positive pictures than stimulant-related pictures compared to controls. Asterisks (**) indicate significant differences less than .01.

Self-Reported Insight and Degree of Behavioural Insight

Three Pearson correlations were performed for the second exploratory research question to identify the relationship between the SAS and the degree of insight obtained from the probabilistic choice task across groups. There were no significant correlations between SAS and the degree of insight for all three groups (all *p's* > .05).

3.5 Change in Insight

For the third exploratory research question, a Fisher's exact test was performed to identify whether a change in insight from baseline to the second time point occurs across groups. There were no significant differences between groups and changes in insight ($p = .14$).

Discussion

This study is the first to explore the relationship between insight and concurrent disorders, particularly those with stimulant-specific co-occurring diagnoses. Our findings revealed several key insights into the complex interplay between cognitive deficits, substance use, and insight.

With regard to our research questions, our results indicated that when controlling for working memory, no significant differences in insight were observed across the three groups. This finding suggests that working memory capacity plays a critical role in the behavioural task used to measure insight, potentially mediating the relationship between cognitive

function and substance use behaviours. Cognitive deficits, like impairments in working memory, are highly prevalent in both substance use disorders (Bruijnen et al., 2019) and mental health disorders (McCleery & Nuechterlein, 2019)and have been identified as a factor in treatment outcomes. Thus, these deficits could interfere with performance on the task, as our findings suggest that beyond disorder diagnosis, it is the working memory, and potentially the ability to remember what pictures were chosen, that is being measured. While this task has demonstrated insight in a population with cocaine use disorder while controlling for cognitive deficits (Moeller et al., 2010), there may be a limitation to the task's effectiveness in cognitively impaired populations (Maracic & Moeller, 2021), such as those with concurrent disorders. This finding raises important questions about the validity of using behavioural tasks that rely on cognitive function, such as working memory, to assess insight in individuals with concurrent disorders. It may be necessary to develop alternative measures less dependent on cognitive capacity or to consider the influence of cognitive deficits when interpreting task performance in this population.

With regard to our exploratory aims, we identified that individuals with stimulant-specific concurrent disorders were significantly more likely to choose stimulant-related photos over pleasant photos compared to controls. This preference suggests a potential attentional bias and implicit cognitive processes selective towards stimulant-related stimuli, a phenomenon that has been widely observed in addiction research. According to the incentive salience theory, this bias may reflect the heightened motivational significance or "salience" that these individuals assign to drug-related cues, driven by underlying neural mechanisms that prioritize the pursuit of drug-related rewards (Robinson & Berridge, 2003; Field & Cox, 2008). Interestingly, this finding may not directly reflect impaired insight but rather a manifestation of the core features of addiction, such as incentive salience and attentional bias. Repeated exposure to stimulants can lead to sensitization of the mesolimbic dopamine system, which amplifies the motivational "wanting" for drug-related cues, even if the actual pleasure derived from the drug ("liking") does not increase (Robinson & Berridge, 2024). This process is what drives individuals to pay more attention to and pursue drug-related stimuli with greater intensity, even in the absence of conscious desire or enjoyment (Robinson & Berridge, 2024). As a consequence, individuals with stimulant-specific concurrent disorders might be more focused on stimulant-related cues over pleasant cues. This attentional capture, driven by the heightened salience of drug cues, contributes to ongoing difficulties in maintaining abstinence (Robinson & Berridge, 2024).

This study also identified that individuals with non-stimulant-specific concurrent disorders were more likely to choose stimulant-related photos over neutral ones compared to controls. However, no difference was found between controls and those with stimulant-specific concurrent disorders or between the two concurrent disorder groups. This preference

could be explained by enhanced novelty-seeking, where individuals are drawn to novel or unusual stimuli, a tendency that is often heightened in those with substance use disorders and psychiatric disorders (Zuckerman, 1994). Moreover, some of these individuals may have a history of stimulant use that was not formally diagnosed at intake, influencing their response to stimulant-related cues despite the absence of a current stimulant-specific diagnosis. This could suggest that prior exposure to stimulants creates a lasting attentional bias towards drug-related stimuli, even in the absence of ongoing use or treatment specific to stimulant disorders (Boileau et al., 2006).

To identify whether insight changes over time, we compared two time points and found no change in insight in any of the groups. There is evidence that insight is modifiable, but some research suggests that there is critical time periods involved (Slepecky et al., 2018). While we did not find a change over time, this may support different theoretical components of insight, suggesting that insight holds both trait and state characteristics (Wiffen et al., 2010). Within concurrent disorders, trait insight may be more prevalent and is independent of substance use and treatment state, in contrast to a state aspect, which is context dependent. Additionally, our study population was assessed after initial inpatient stabilization and thus may have undergone an initial period of developing some insight, as suggested by Slepecky et al. (2018).

With that, our findings should be considered alongside their limitations. A limitation of this study is the relatively small sample size, specifically within the non-stimulant-specific concurrent disorder group. This limits the statistical power and generalizability of the findings. The heterogeneity within the concurrent disorders group, encompassing a wide range of mental health diagnoses, further complicates the interpretation of results, as different psychiatric disorders may variably impact insight and cognitive function. Moreover, the inpatient treatment environment could influence insight over time, potentially confounding the interpretation of baseline and follow-up measures. The study also faces challenges with substantial missing data at the second time point, particularly among participants with concurrent disorders, which could introduce bias if the attrition is related to the participants' characteristics. Additionally, the lack of control over participants' substance use during the study period may introduce further variability, affecting cognitive function and insight. Finally, relying on a single behavioural task to assess insight might not capture the multifaceted nature of insight, potentially overlooking other significant aspects relevant to this population. Addressing these limitations is crucial for refining future research and improving the assessment of insight in individuals with concurrent disorders.

Future research should further explore the mechanisms underlying the observed relationships between cognitive function, attentional bias, and insight in individuals with concurrent disorders. Longitudinal studies could help clarify whether improvements in cognitive function lead to better

insight and whether such improvements translate into more effective substance use treatment outcomes.

Implications

In summary, our study is the first to look at insight measured as recognition of behavioural preference of drug-related pictures in a population of individuals with co-occurring substance use disorders and mental health disorders. Those with concurrent disorders have a pronounced preference for pictures associated with stimulant cues, which did not change over time, suggesting that within the population tested, this may be a persistent condition. This study provides new insights into the complex interactions between cognitive deficits, substance use, and insight among individuals with concurrent disorders. While the findings underscore the challenges of measuring insight in this population, they also point to potential avenues for enhancing treatment for those with concurrent disorders, such as attentional bias modification, to reduce cue-reactivity. Additionally, given the role of working memory in insight, cognitive remediation therapies may help improve decision-making and substance use regulation. Future research should explore integrating cognitive interventions with psychosocial treatments to enhance outcomes for this population.

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Availability of data and material

Data will be made available upon reasonable request.

Conflict of Interest

None declared.

Author's Contributions

Tanisse Epp: Conceptualization, Methodology, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Project Administration; **Karling Luciani:** Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization; **Alyssa Turcott**: Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Project Administration; **Keenan Klassen:** Conceptualization, Methodology, Writing – Original Draft, Writing – Review & Editing; **Christian Schütz:** Conceptualization, Methodology, Resources, Data Curation, Writing – Original Draft, Writing – Review & Editing, Supervision, Project Administration, Funding acquisition.

Ethics Approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

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