Drug and Alcohol Dependence 229 (2021) 109133

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Different drugs come with different motives: Examining motives for substance use among people who engage in polysubstance use undergoing methadone maintenance therapy (MMT)

Ioan T. Mahu [a,*], Sean P. Barrett [a,b], Patricia J. Conrod [c,d], Sara J. Bartel [a], Sherry H. Stewart [a,b]

[a] Department of Psychology & Neuroscience, Dalhousie University, Life Sciences Centre, 1355 Oxford Street, PO BOX 15000, Halifax, NS B3H 4R2, Canada
[b] Department of Psychiatry, Dalhousie University, 5909 Veterans' Memorial Lane, 8th Floor, Abbie J. Lane Memorial Building, QEII Health Sciences Centre, Halifax, NS B3H 2E2, Canada
[c] Department of Psychiatry and Addictology, University of Montreal, Université de Montréal, Pavillon Roger-Gaudry, C.P. 6128, succursale Centre-ville Montréal (Québec) H3C 3J7, Canada
[d] Ste-Justine Hospital, Centre de Recherche, 3175 Chemin de la Côte-Sainte-Catherine, Montréal, QC H3T 1C4, Canada

ARTICLE INFO

Keywords:
Polysubstance Use
Motives
Opiate agonist therapy
Methadone
Opioids

ABSTRACT

Background: Substance use motives (i.e., reasons for using a substance) are thought to be the most proximal variable leading to substance use. These motives have been described by various typologies, the most well known being the four-factor drinking motives model which separates motives into enhancement, social, coping, and conformity (Cooper, 1994). Although extensively studied in adult community samples, motives for use have less commonly been investigated among populations at a later stage of addiction, where polysubstance use is more common. Moreover, because the motives literature has largely focused on drinking motives, it is not clear whether existing findings can also be applied to other substances (Cooper et al., 2016).

Methods: Using Zero-inflated beta Bayesian linear mixed modeling, we investigated the stability of seven distinct substance use motives (enhancement, social, expansion, coping with anxiety, coping with depression, coping with withdrawal, and conformity) across six different drug categories (tobacco, alcohol, cannabis, opioids, stimulants, and tranquilisers) to determine the extent to which drug class can influence motive endorsement. One-hundred-and-thirty-eight methadone maintenance therapy (MMT) clients (F = 34.1%; M = 65.9%; age = 40.18 years) completed a novel short-form polysubstance motives questionnaire.

Results: External motives (i.e., conformity and social motives) were the most stable across drug categories, while all internal motives (i.e., enhancement, expansion, and all three coping motives) demonstrated varying levels of inter-drug variability.

Conclusions: These findings have important implications for prevention and intervention strategies among people who engage in polysubstance use, highlighting the importance of both universal and substance-specific programming.

According to motivational theory (Cox and Klinger, 1988), substance use behaviours are driven by psychologically distinct need states and dispositions, also known as substance use *motives*. These motives are regarded as the final common pathway to substance use and misuse, through which personality or other less proximal risk variables exert their effects (Cooper, 1994). Motivational theory led to the development of the well known four factor drinking motives model (Cooper, 1994; Cooper et al., 2016), which differentiates drinking motives based on two dimensions: (1) approach versus avoidance goals (e.g., the pursuit of pleasurable incentives vs the avoidance of negative states; Gray, 1970, 1987), and (2) whether the source of the motive originates in the self vs social environment. Crossing these two dimensions leads to four categories of motives: internal approach motivations (i.e., enhancement motives), internal avoidance motives (i.e., coping motives), external approach motives (i.e., social motives), and external avoidance motives (i.e., conformity motives). These four motives have been extensively

* Correspondence to: Department of Psychology and Neuroscience, Dalhousie University, Life Sciences Centre, 1355 Oxford Street, PO BOX 15000, Halifax, NS B3H 4R2, Canada.
E-mail address: ioan.tiberiu.mahu@dal.ca (I.T. Mahu).

https://doi.org/10.1016/j.drugalcdep.2021.109133
Received 15 July 2021; Received in revised form 10 September 2021; Accepted 4 October 2021
Available online 30 October 2021

studied in relation to alcohol, and have been linked with a number of distinct antecedents and consequences (for a review, see Cooper et al., 2016).

Subsequent research has refined this initial four-factor model (Cooper, 1994) through the inclusion of additional motives (e.g., expansion motives for cannabis; Simons et al., 1998; Zvolensky et al., 2007) and through the differentiation of coping motives into coping with anxiety and coping with depression (i.e., Modified Drinking Motives Questionnaire-Revised [M-DMQ-R]; Grant et al., 2007). Other motives with high relevance for clinical populations, such as coping with withdrawal, have also been proposed (Blevins, Lash, and Abrantes, 2018; Valente et al., 2020). However, the latter are currently understudied and not included in the latest revision of the DMQ scale (Grant et al., 2007).

While a vast literature on substance use motives exists, most studies focused on drinking motives with youth or healthy adults (Cooper et al., 2016). Relatively fewer studies have investigated the DMQ or its adaptations in treatment-seeking or clinical populations at a later stage of addiction (Blevins et al., 2018; Foster, Buckner, Schmidt, and Zvolensky, 2016; Gavrilova, Blevins, and Abrantes, 2020; Hammarberg, Öster, and Nehlin, 2017; Jones, Spradlin, Robinson, and Tragesser, 2014; Mezquita et al., 2011; Öster, Arinell, and Nehlin, 2017; Schlauch et al., 2015). Clinical samples differ from the general population not only in their motives for use, which tend to be more focused around coping (Mezquita et al., 2011; Thornton et al., 2012), but also in regards to higher rates of polysubstance use (i.e., using multiple drugs on the same occasion or on separate but recent occasions; Crummy et al., 2020). For example, polysubstance use has been documented to occur in over 90% of individuals entering treatment for opioid use disorders (Cicero et al., 2020), and appears to remain common in populations receiving methadone maintenance therapy (MMT; Compton et al., 2021; Taylor, 2015). Given polysubstance use is associated with increased risk of adverse events in clinical populations (e.g., heightened overdose risk with certain drug combinations; Compton et al., 2021), investigating motives across a variety of substances among clinical populations, like patients with opioid use disorder, is particularly important for determining whether treatment planning should take a universal or substance specific approach.

Unfortunately, the majority of the motives literature utilizes cross-sectional designs examining a single substance, with a spotlight on alcohol (Cooper et al., 2016). Although a few researchers have attempted to adapt the DMQ-R to specific substances, such as cannabis (Simons et al., 1998), opioids (Jones et al., 2014), stimulants (Thurn, Kuntsche, Weber, and Wolstein, 2017; Thurn, Riedner, and Wolstein, 2020), or "designer drugs" (Benschop et al., 2020), this has resulted in a variety of slightly different measures making direct comparisons between substances challenging. Moreover, each measure often includes 20 + items (e.g., Cooper, 1994; Simons et al., 1998), resulting in significant participant burden when administered for multiple substances.

Related to these limitations, an often-debated question relates to whether these motivational dynamics are common or specific to a given substance. Because different substances have varying pharmacological effects, we may expect motives to differ between different substances within the same individual; however, few studies have directly compared motives across different substances (Biolcati and Passini, 2019; Blevins et al., 2018; Gavrilova et al., 2020; Villarosa-Hurlocker et al., 2019). Indeed, although we often think of motives as being fixed, trait-like attributes of individuals (e.g., Windle and Windle, 2018), some longitudinal and daily diary research (e.g., Arbeau et al., 2011; Joyce et al., 2018) suggests that motives can vary significantly from situation to situation or across time (Cooper et al., 2016). Currently, we do not fully understand whether motives present as trait-like (show little variability across drugs) and/or state-like (show substantial variability across drugs) across a wide range of substances within the same individuals (to control for within-person variability). Gaining a better understanding of the motivational dynamics across substances would be of great theoretical and practical utility.

1. Objectives and hypotheses

The current paper addresses the above-mentioned gaps in the literature related to assessing motives in clinical populations engaging in polysubstance use. We introduce a novel brief motives measure to assess motives across a wide range of substances, with completion times of under one minute per substance. Additionally, we demonstrate the use of a conditional hierarchical model suitable to non-balanced data, as we examine how motive endorsement differs across six different drug categories (tobacco/nicotine, alcohol, cannabis, stimulants, opioids, and tranquilisers) in a sample of MMT clients with various levels of recent (i.e., past 30-days) polysubstance endorsement. While we previously reported on the relations of personality to substance use in this sample (Mahu et al., 2019), we now turn our attention to substance use motives. Given that our included drug categories have varying pharmacological effects and phenomenological experiences, we expected motive endorsement to differ significantly between certain drug categories (Cooper et al., 2016), as indicated in the seven hypotheses in Table 1.

2. Methods

2.1. Participants

We recruited 138 participants from four MMT clinics located in the Halifax Regional Municipality (n = 2) and Montreal (n = 2). The mean age of the sample was 40.18 years (SD = 11.56, range 21–71 years), with

Table 1
Study Hypotheses by Motive.

Hypotheses	Rationale
(H1) Enhancement Motives	We expected enhancement motives to be higher for all drug categories relative to tranquilisers. Enhancement motives have been frequently endorsed for alcohol, cannabis, and tobacco in the general population (Cooper et al., 2016), while substances acting more directly on dopaminergic pathways (e.g., stimulants) have also been related to enhancement motives in clinical populations (Thurn et al., 2017, 2020). Given their subjective euphoric effects, high enhancement motives have also been linked to opioid use (Barth et al., 2013; Jones et al., 2014).
(H2) Social Motives	We expected social motives to be endorsed more strongly for alcohol and cannabis, relative to all other drugs, given the social nature of these substances (Cooper et al., 2016).
(H3) Expansion Motives	We expected expansion motives to be more strongly endorsed for cannabis relative to alcohol and tobacco, given prior work establishing expansion motives as important for cannabis use (Simons et al., 1998).
(H4) Coping with anxiety	We expected coping with anxiety motives to be most strongly endorsed for drugs with anxiolytic properties (e.g., tranquilisers), relative to all other drugs (Stein, Kanabar, Anderson, Lembke, and Bailey, 2016). Due to their physiological arousal-enhancement effects, we expected stimulants to be least associated with this motive relative to all other drugs (Blevins et al., 2018).
(H5) Coping with depression	We expected coping with depression motives to be most endorsed in drugs with short-term antidepressant properties, such as alcohol (Ciccocioppo et al., 1999; Wolfe et al., 2016) and opioids (Gold et al., 2020; Rouine et al., 2018; Saxena and Bodkin, 2019) relative to all other drugs.
(H6) Conformity Motives	We did not expect this motive to show any differences across substances among adult MMT clients, as this motive is more commonly endorsed among younger age groups (Cooper, 1994).
(H7) Withdrawal	We expected this motive to be more commonly endorsed in substances with severe physical withdrawal symptoms (e.g., alcohol, tobacco, opioids;Blevins et al., 2018;Cooper et al., 2016;Rigg and Ibañez, 2010) and for tranquilisers, which have been used to cope with withdrawal among opioid dependent populations (Stein et al., 2016), relative to all other drugs.

the majority identifying as men (65.9%). Most participants were White (79.7%), with Indigenous and Black clients making up 10.9% and 2.2% of the sample, respectively; the remaining 7.2% were from other racial/cultural groups. About half of the sample was employed (51.5%), had attained an educational level not exceeding high school (42.8%), and identified as single (i.e., never married; 55.8%). The only inclusion criterion was being a daily witnessed methadone maintenance therapy (MMT) client at one of the four participating clinics for at least the past 30-days. This was because MMT was the most commonly administered form of OAT at the clinics we collaborated with at the time of data collection (2015–2016), and we wanted to minimize any variability in outcomes that may relate to form of OAT. On average, clients received a daily methadone dose of 78.64 mg (SD = 40.15).

2.2. Procedure

Participants were approached by clinic staff and research team members to participate in the study. Testing took place in a private space at each clinic site. After providing informed consent, participants completed questionnaires from a larger battery. This study was approved by institutional research ethics boards at each site.

2.3. Materials

2.3.1. Substance use interview (Gross, Barrett, Shestowsky, and Pihl, 2002)

Participants completed an author-compiled structured interview assessing lifetime and recent (past-30 days) use of alcohol, cannabis, amphetamines, hallucinogens, opiates, cocaine, and prescription drugs, among other more detailed follow-up questions (see supplemental materials for a copy of this interview guide). To maximize the validity of this self-reported data, we posed questions in an open-ended format and reminded participants that the interview was confidential and that there would be no negative consequences (i.e., with respect to their MMT services) to reporting substance use. A sham-drug item (i.e., *"Have you used kiaran in the past 30-days?"*), intended to screen for over-reporting, was included. Participants who endorsed using any substance in the past 30-days then completed a polysubstance motives measure on the reasons for their use of that substance in the past 30-days. Motives data for pharmacologically similar substances were averaged and combined into "drug classes", e.g., stimulants (cocaine, crack, prescription stimulants, other stimulants) and opioids (heroin, prescription opioids), to make use of all available data.

2.3.2. Polysubstance motives measure (PMM)

To assess motives for use across multiple substances, we developed a brief, short form VAS motives measure based on Cooper's (1994) four-factor motivational model, Grant et al.'s (2007) Drinking Motives Questionnaire-Revised (MDMQ-R), and Simons et al.'s (1998) Marijuana Motives Measure (MMM). We used the approach to short form test development used by Breslin et al. (2000) and Smith et al. (2011) to develop the seven PMM items (included in the supplemental files). Specifically, each item of the PMM reflects one of the major motive dimensions discussed in the literature: enhancement, social, conformity, coping with depression, coping with anxiety, and expansion. An additional coping with withdrawal symptoms item was added due to its clinical relevance to MMT clients. Two of the authors with experience in motives research examined items from the MDMQ-R (Grant et al., 2007) and the MMM (Simmons et al., 1998) and selected the most face-valid indicators of each theoretical construct. Based on discussion and consensus, the most face-valid item was selected, shown first, and bolded (e.g., "In the past 30 days, I've used this drug because it enhances my pleasure" for measuring the enhancement motive). Each of the major motive dimensions was immediately followed up in parentheses by two other face-valid items also reflecting that motive dimension (e.g., "because it's exciting, or to get a high/buzz" for enhancement motives), such that each item of the PMM included three different items found in other motive scales. Participants responded by drawing a line on a 10-cm visual analog scale ranging from "never" (0) to "always" (10) to indicate their endorsement of each motive, which was measured as a proportion of recent use occasions. A separate PMM questionnaire was administered for each drug class endorsed in the past 30 days.

2.4. Statistical analysis

Linear Mixed Modeling (LMM) using Bayesian Estimation was performed using the brms package (Bürkner, 2017), running on the rstan package (Stan Development Team, 2020) in R version 4.0.3 (R Core Team, 2013). Models were conceptualized as multi-level, zero-inflated beta-distribution models, with multiple measurements (level 1) nested within individuals (level 2). Random intercepts were modeled for each participant. A third set of supplemental models with relevant co-variates (age, gender, site, methadone dosage, and past 30-day methadone compliance) is available in the online materials. An additional interaction model (drug class X methadone dose and compliance) was also examined for withdrawal motives only. More details on model specification can be found in the supplemental materials.

To establish whether specific motives are more trait-like or state-like across substances, a deviance score was computed for each motive by calculating the proportion of pairwise difference values from the entire posterior distribution (n = 4000) which fall outside of the region of practical equivalence (ROPE). This ROPE was set such that a difference of 20% or less (equivalent to a range of −0.1 to +.1 on a standardized parameter) would correspond to a negligible effect size (Kruschke and Liddell, 2017). A lower deviance score highlights a high proportion of equivalent pairwise differences in drug categories, and therefore a higher likelihood that such a motive is more trait-like. In contrast, the higher this deviance score, the more variability exists across drug categories, providing evidence that a particular motive is state-like.

3. Results

Participant demographics and substance use characteristics in this sample were reported in a previous publication (Mahu et al., 2019). Briefly, no participants endorsed the sham drug item, providing a data quality check. Participants used a median of 3 (IQR = 1) drug classes in the past 30 days. Model coefficients, Bayesian R^2, and intraclass correlational coefficient (ICC) for each outcome can be found in the online supplementary Table 1 for both non-adjusted models and co-variate adjusted models (due to missing data on some covariates, adjusted models N = 131). Of note, the ICC indexes the proportion of variance that is explained by the grouping factor (i.e., variation at the upper-level units, in this case subjects), and describes the variability in motive endorsement that is explained by subject characteristics. Typically, the ICC ranged between 2% and 9%, with the notable exception of conformity motives, where 29% of the variance was explained by subject characteristics. Conditional R^2 for each model suggested that we were able to explain between 14.6% and 21.2% of the total conditional variance in motive endorsement by drug class.

Fig. 1 plots the model-predicted motive endorsement within each drug category and within each motive. As results remain very similar after controlling for relevant co-variates (see supplemental Fig. 1), we will focus our discussion on the original non-adjusted models. Fig. 2 depicts the rank ordered endorsement of each motive across each drug category. Pairwise differences between each drug combination for all motives are displayed in online supplemental Fig. 2 and included in online supplementary Table 2. Overall, drug category is an important predictor of the variance in all motives other than conformity motives, and to a lesser extent, social motives (Fig. 3). Briefly, these significant differences (i.e., where zero is not included in the 95% credible interval) are as follows:

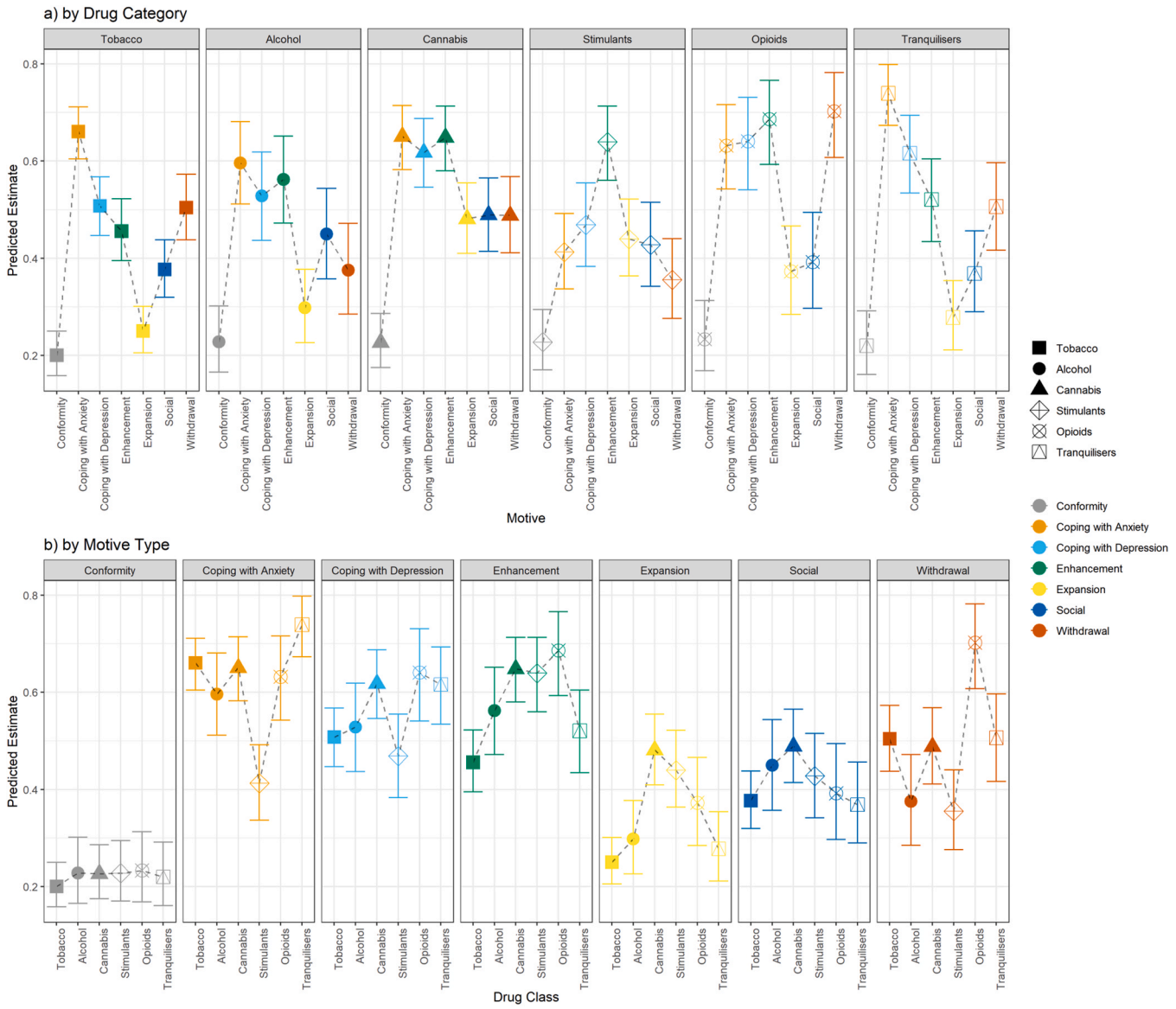

Fig. 1. Motive endorsement by Drug Class. Note. The same data is faceted by drug category (a), to enable comparisons of motives across drug classes, and by motive type (b), to enable comparisons of drug classes across motives. Error bars represent 95% credible intervals for estimates derived from the conditional models.

1. ***Enhancement***. Participants endorsed enhancement motives for using cannabis, stimulants, and opioids more so than for tobacco and (consistent with H1) tranquilisers (online supplemental Fig. 2, green). Overall, enhancement motives were endorsed as one of the top three motive categories across all drugs except tobacco, where they ranked 4th. Enhancement motives were ranked 1st in terms of importance for stimulants (Fig. 2). Enhancement motives showed both trait and state-like properties as evidenced by the large proportion of non-equivalent drug differences (deviance score = 0.52; Fig. 3).
2. ***Social.*** Providing only partial support for H2, social motives were endorsed similarly for most drugs surveyed, showing little evidence of specificity towards alcohol and cannabis. Social motives were more strongly endorsed for cannabis relative to both tranquilisers and tobacco (online supplemental Fig. 2, dark blue). Relative to all other motives, social motives typically hovered in the middle in terms of relative endorsement across all categories of drugs (Fig. 2). Social motives mainly displayed trait like qualities (deviance score = 0.27; Fig. 3).
3. ***Expansion.*** Expansion motives were endorsed more frequently for cannabis relative to tobacco, alcohol, and tranquilisers (consistent with H3); for stimulants relative to alcohol, tobacco, and tranquilisers; and for opioids relative to tobacco and tranquilisers (online supplemental Fig. 2, yellow). However, compared to all other motives, expansion motives were most frequently ranked at the bottom of the list, ranking 3rd only with stimulants (Fig. 2). Expansion motives showed both trait and state-like properties (deviance score = 0.55; Figure3).
4. ***Coping with Anxiety.*** Consistent with H4, all drug classes were endorsed more frequently than stimulants to cope with anxiety. Additionally, partially consistent with H4, participants reported using tranquilisers to cope with anxiety more frequently than alcohol, cannabis, stimulants, and opioids (online supplemental Fig. 2, orange). This motive was also endorsed more frequently for tranquilisers relative to tobacco, although zero was included in the upper limit of the 95% credible interval. Ranked against other motives, coping with anxiety motives were highly ranked for almost all drugs, featuring in the first spot for tobacco, alcohol, cannabis, and tranquilisers (online supplemental Fig. 2). Coping with anxiety

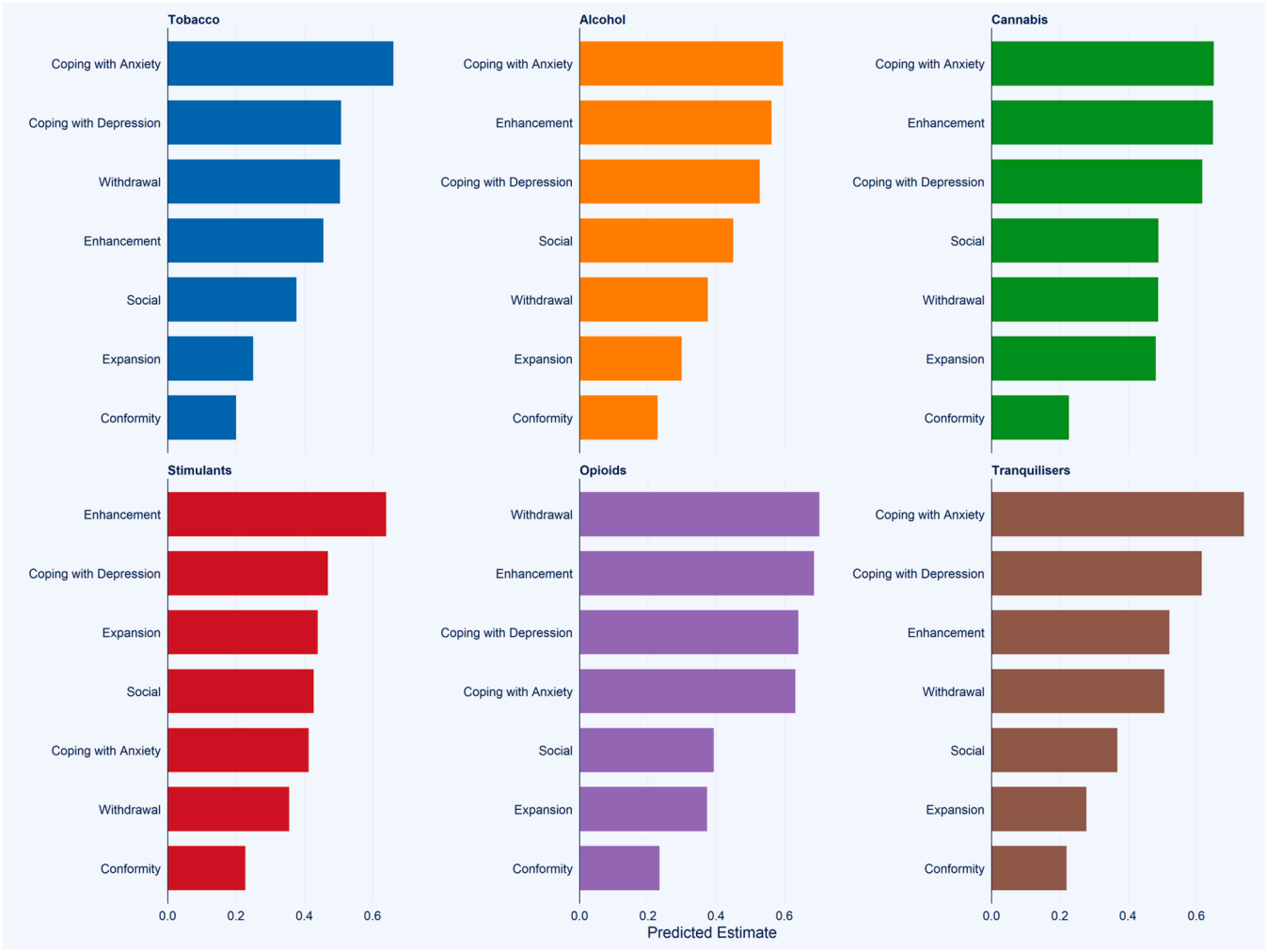

Fig. 2. Motives Ranked by Descending Order of Endorsement Across Drug Categories. Note. Motives were ranked from the most frequently endorsed to the least frequently endorsed as a proportion of past 30-day use occasions across each drug category.

motives showed both trait and state-like properties (deviance score = 0.51; Fig. 3).

5. ***Coping with Depression.*** Although largely similar to coping with anxiety, coping with depression motives evidenced some specificity with tobacco and tranquilisers being endorsed less frequently for coping with depression than anxiety (Fig. 1). Partially supporting H5, coping with depression motives were most strongly endorsed for both opioids and cannabis relative to tobacco and stimulants. Tranquilisers were more frequently endorsed for this motive relative to stimulants (online supplemental Fig. 2, light blue). Coping with depression motives were consistently in the top 3 most endorsed motives across all drug categories (Fig. 2). Moreover, this motive dimension showed evidence of both trait and state-like properties (deviance score = 0.43, Fig. 3).
6. ***Conformity.*** Consistent with H6, conformity motives were seldom endorsed for all substances and showed no differences between drugs (online supplemental Fig. 2, gray). Conformity motives showed the strongest evidence of trait-like properties (deviance score = 0.02, Fig. 3).
7. ***Withdrawal.*** Consistent with H7, relative to all other substances, coping with withdrawal motives were most strongly endorsed for opioids. Withdrawal management was also more commonly endorsed for cannabis, tobacco, and tranquilisers relative to alcohol and stimulants. Withdrawal motives were ranked 1st relative to all other motives when looking at opioids specifically, and 3rd for tobacco (Fig. 2). These results were largely maintained even after controlling for interactions with methadone dosage and compliance. Higher methadone dosage interacted with drug class, resulting in decreased probability of reporting any motives for alcohol and opioids in the zero-inflated model (i.e., associated with lower prevalence of use); while in the conditional model, higher methadone dosage was associated with lower endorsement of withdrawal motives for opioids specifically (online supplementary Figure 3). Relative to the other motives, withdrawal motives appeared to be the most sensitive to drug effects, and therefore most state-like (deviance score = 0.63, Fig. 3).

4. Discussion

Our results suggest that there is both stability and variability in motive endorsement across separate drug categories among MMT clients, providing initial validity of this new motives measure in polysubstance contexts and furthering the growing literature on substance use motives in clinical populations. Using a deviance score calculated as a proportion of non-equivalent differences, external motives (i.e., conformity and social) showed the least variation across substances (and therefore, most stability), highlighting that external motives most closely resemble a trait-like pattern. In contrast, internal motives (i.e., expansion, enhancement, and all three coping motives) showed much more variability across substances and thus exhibited varying levels of

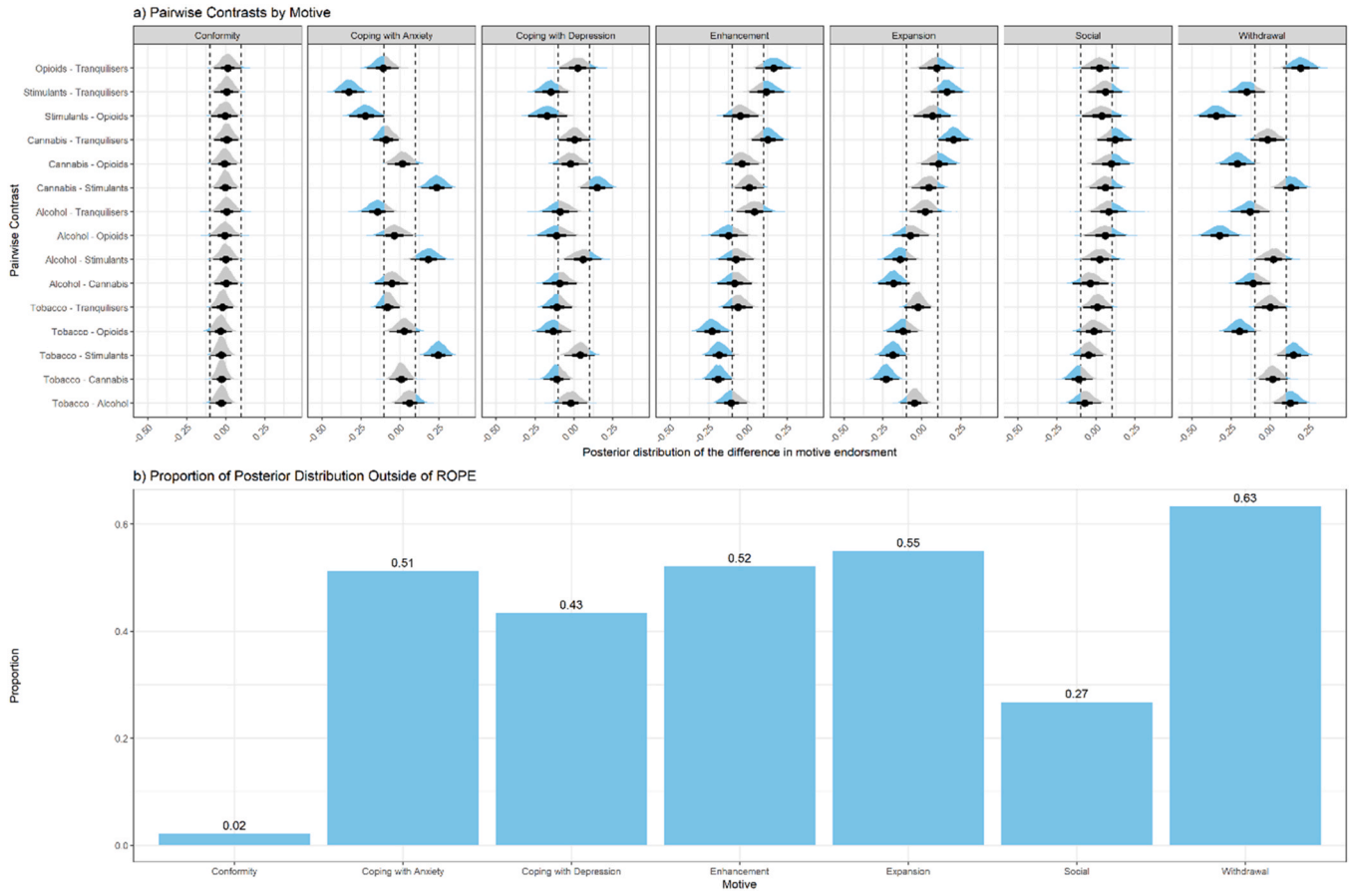

Fig. 3. Pairwise Drug Contrasts. Note. ROPE = Region of Practical Equivalency. All possible pairwise drug contrasts (n = 15) were calculated by subtracting relevant model parameters and transforming to the original scale (0−1). Density plots display the full posterior distribution (4000 draws) of all possible difference values given the data for each motive. A positive difference indicates evidence towards motive endorsement being higher in the first item of the contrast pairing, while a negative difference indicates evidence towards motive endorsement being higher in the second item of the contrast pairing. The point estimate (black dot) displays the median and most credible difference value (see online supplemental Table 2 for details). The thin vertical black bar reflects the 95% credible interval, while the thicker black bar reflects the 50% credible interval. (a) The ROPE was set at 20%, centered around 0, meaning that a difference of plus or minus 0.1 on a standardized parameter was judged as being equivalent. This is visualized as the vertical dashed lines around zero. Non-equivalent values outside of this ROPE in the posterior distribution of pairwise differences are highlighted in sky blue and were used to compute the deviance score plotted at b). (b)The proportion of non-equivalent difference values was calculated based on exceeding the ROPE. This deviance score outlines the extent to which each motive is sensitive to drug effects. A higher deviance score provides evidence that motive endorsement is less stable across drug categories, as a higher proportion of possible difference values are non-equivalent. Taken together, this score described the extent to which motives generalize across drug categories (trait-like or a low deviance score) or are moderated by drug categories (state-like or a high deviance score).

state-like properties, suggesting that some motives are at least in part linked to the effects of specific substances.

4.1. External motives

Although conformity motives were highly stable, they were also infrequently endorsed in the sample overall. The developmental importance of conformity motives among youth as opposed to adults likely explains the overall low endorsement of this motive among adult MMT clients. Indeed, conformity is thought to be a more important motive among adolescents or younger substance users (Cooper, 1994), and future studies should test the stability of this motive across substances using this measure among youth.

Similarly, social motives were relatively stable across substances, showing higher relative endorsement only for cannabis when compared with tobacco and tranquilisers. This suggests that alcohol, cannabis, stimulants, and opioids all appear to be used for social reasons among MMT clients, in at least roughly 40% of use occasions in the past month.

4.2. Internal motives

Almost all substance use in our sample was heavily motivated by coping with anxiety. Consistent with our hypothesis (H4) informed by their anxiolytic medicinal properties, tranquilisers are used more frequently for this motive relative to all other drugs. In contrast, and consistent with their anxiogenic pharmacological effects, stimulants were less frequently endorsed for this motive relative to all other drugs, replicating and extending to MMT clients, the findings of Blevins et al. (2018) among an inpatient sample. Therefore, coping with anxiety primarily shows state-like properties through its specific relationship with tranquilisers and stimulants.

Coping with depression motives showed a very similar pattern to coping with anxiety motives. This supports similar findings suggesting that differentiating these two coping motives can be difficult among clinical samples of substance users given high rates of psychiatric comorbidity (Schlauch et al., 2015). Nevertheless, our approach yielded some specificity between the two coping motives when looking at both tobacco and tranquilisers, which were used primarily for coping with anxiety relative to coping with depression motives. This suggests that there may be some utility in keeping both coping motives distinct when

examining motives for specific substances, particularly as the two coping motives have been related to different outcomes (Grant et al., 2007).

Enhancement motives (e.g., to get "high") were endorsed highly for most substances, with the exceptions of tobacco and tranquilisers. Tobacco has traditionally been more closely related to habit and dependence motives for use (Cooper et al., 2016) – two motives not examined in the present study. And tranquilisers largely have sedative effects which run counter to the desired stimulation inherent in enhancement motives. MMT clients therefore appear to frequently endorse enhancement motives for opioids, stimulants, alcohol, and cannabis.

Expansion motives were most commonly endorsed for cannabis, which is unsurprising given that the original items were developed specifically for cannabis (Simons et al., 1998). However, expansion motives were also endorsed fairly commonly and similarly for opioids and stimulants; the latter replicates a result found in college students (Blevins, Stephens, and Abrantes, 2017), suggesting that motives for increasing experiential awareness extend beyond cannabis and should be studied in relation to other substances as well.

Consistent with literature suggesting that withdrawal management is an important motive among opioid dependent populations (Barth et al., 2013; Blevins et al., 2018; Macmadu, Carroll, Hadland, Green, and Marshall, 2017), coping with withdrawal motives were the most strongly endorsed motive for opioids relative to all other drugs in our MMT sample, even after accounting for methadone dose and compliance. While daily compliance with the methadone treatment (i.e., not missing a dose) seemed to be associated with lower probability of opioid use, higher methadone dose was associated with reduced endorsement of withdrawal motives among those who did recently use opioids. This is in line with other studies showing that a higher methadone dosage seems to be more effective at managing opioid craving and relapse (Farnum et al., 2021; Langleben et al., 2008; Mattick, Breen, Kimber, and Davoli, 2014). Although endorsed less frequently than for opioids, withdrawal motives were still fairly common and endorsed similarly for tobacco, cannabis, and tranquilisers, suggesting that MMT clients (1) also use those substances to cope from their respective withdrawal effects (e.g., tobacco), and/or (2) they use those substances to manage withdrawal symptoms from other drugs (e.g., cannabis to manage opioid withdrawal, Lucas, 2017; Socías et al., 2018). Unfortunately, as we did not ask participants to specify the substances responsible for their withdrawal symptoms, we cannot determine for certain which of the above is most likely. Future use of this withdrawal motives item could ask participants to specify from which substance or substances they are withdrawing.

4.3. Limitations

These results need to be interpreted with certain limitations in mind. First, future studies will benefit from larger samples as more data will yield more precise estimates. A larger sample will also allow for more precise estimation of individual drug effects within the same drug class (e.g., cocaine vs. prescription stimulants) without collapsing across drug categories. Second, this data was collected at a time when MMT was the most popular form of OAT, with many clients that had been on MMT for over a year, while now the gold standard has shifted towards buprenorphine/naloxone (Bruneau et al., 2018). Future studies will need to investigate whether these results hold for other forms of OAT, such as buprenorphine/naloxone, or for newer MMT clients. Third, although we added a withdrawal motive and highlighted its importance for MMT clients, there are unmeasured motives that may also be particularly relevant to clinical populations, such as coping with pain and boredom/habit (Blevins et al., 2018). The absence of a pain motive is a particular weakness in an opioid use disorder sample. Fourth, we only used one item per motive (albeit with three examples), making direct comparisons with multi-item measures more difficult, not allowing us to assess reliability, and potentially introducing more measurement error relative to well constructed multi-item measures. However, its brevity is also a strength of our scale, allowing for quick and efficient deployment in clinical and research (e.g., polysubstance use, daily diary studies) settings. Recently, this measure has been slightly updated, undergone expert review, and been further validated by Bartel et al., 2021 (submitted), showing excellent face, content and concurrent validity, as well as theoretically-relevant associations between motives and alcohol/-cannabis outcomes. Fifth, our author-compiled, non-standard substance use interview makes direct comparison to other studies more difficult and may limit the generalizability of these findings. Sixth, we did not differentiate between prescribed vs. non-prescribed usage of prescription drugs, and results may not generalize to samples that engage exclusively in either medically-sanctioned use or misuse. Finally, we conceptualized the question of state versus trait through a contextual perspective (i.e., choice of drug) rather than a temporal perspective, and cannot comment on the temporal stability of these findings as we used a cross-sectional design. Table 2.

5. Conclusions

In summary, we developed a novel measure designed to efficiently assess motives for use across a wide range of substances and provide emerging evidence for its cross-substance discriminant validity. We also advance the literature around the stability of motives across drug categories, suggesting that different motives have varying levels of trait/state properties, which bears important implications for targeted treatment. Clinical interventions targeting trait-like motives are likely to have a general impact on substance use behaviour across drugs, whereas those targeting state-like motives will need to be more specific to the particulars of each substance.

Funding

This work was supported by a Canadian Research Initiative on Substance Misuse (CRISM) Quebec-Atlantic node-funded demonstration project supported by the Canadian Institute of Health Research (CIHR), grant number SMN 139 149. The funder played no role in the study design, collection, analysis, or interpretation of the data, writing the report, or the decision to submit the article for publication.

Contributors

SHS, PJC and SPB designed the study and wrote the protocol. ITM was involved in data collection, conducted all statistical analyses, and wrote the first draft of the manuscript as part of his doctoral dissertation. ITM, SHS, PJC, SPB and SJB were involved in critical revision of the

Table 2
Past 30-day Substance Use and Non-Prescribed Use.

Drug Class	Individual Substances	Total (N = 138)	Total (%)	Non-Prescribed Use (n)	Non-Prescribed Use (%)
Tobacco		121	87.7%	–	–
Alcohol		48	34.8%	–	–
Cannabis		76	55.1%	66	86.8%
Stimulants	Cocaine	24	17.4%	–	–
	Crack	31	22.5%	–	–
	Rx Stimulants	19	13.8%	8	42.1%
	Other Stimulants	8	5.8%	–	–
Opioids	Heroin	11	8.0%	–	–
	Rx Opioids	32	23.2%	28	87.5%
Tranquilisers		58	42.0%	30	51.7%
No substance use		4	2.9%	–	–

Note. Rx = Prescription. Other Stimulants = Street drugs including Methamphetamine, Speed, Crystal Meth, Ice, etc. Dashed lines (–) = not applicable.

manuscript and approved the final draft.

Author disclosures

Conflict of interest

No conflicts to declare.

Acknowledgements

ITM was funded by a Killam doctoral scholarship. SJB was funded by a SSHRC doctoral scholarship. PJC was funded by a senior FRQS Career Award. SPB was funded by CIHR. SHS was funded by a CIHR Tier 1 Canada Research Chair in Addictions and Mental Health. We would also like to extend special thanks to our collaborators at the four MMT clinics for their invaluable help with recruitment: the CRAN team, the Service de médecine des Toxicomanies du CHUM team, the NSHA Central District Withdrawal Management and Opioid Treatment Program team, and the Direction 180 team.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.drugalcdep.2021.109133.

References

Arbeau, K.J., Kuiken, D., Wild, T.C., 2011. Drinking to enhance and to cope: a daily process study of motive specificity. Addict. Behav. 36 (12), 1174–1183. https://doi.org/10.1016/j.addbeh.2011.07.020.

Bartel, S.J., Sherry, S.B., Mahu, I.T., Stewart, S.H., 2021. Development of brief cannabis and alcohol motives measures: psychometric evaluation using expert feedback and longitudinal methods. Cannabis.

Barth, K.S., Maria, M.M.-S., Lawson, K., Shaftman, S., Brady, K.T., Back, S.E., 2013. Pain and motives for use among non-treatment seeking individuals with prescription opioid dependence. Am. J. Addict. 22 (5), 486–491. https://doi.org/10.1111/j.1521-0391.2013.12038.x.

Benschop, A., Urbán, R., Kapitány-Fövény, M., Van Hout, M.C., Dąbrowska, K., Felvinczi, K., Demetrovics, Z., 2020. Why do people use new psychoactive substances? Development of a new measurement tool in six European countries. J. Psychopharmacol. 34 (6), 600–611. https://doi.org/10.1177/0269881120904951.

Biolcati, R., Passini, S., 2019. Development of the substance use motives measure (summ): a comprehensive eight-factor model for alcohol/drugs consumption. Addict. Behav. Reports 10, 100199. ⟨https://www.sciencedirect.com/science/article/pii/S2352853219300963⟩.

Blevins, C.E., Lash, S.J., Abrantes, A.M., 2018. Adapting substance use motives measures for a clinical population of opiate, alcohol, and stimulant users. Addict. Res. & Theory 26 (2), 151–158. https://doi.org/10.1080/16066359.2017.1338689.

Blevins, C.E., Stephens, R., Abrantes, A.M., 2017. Motives for prescription stimulant misuse in a college sample: characteristics of users, perception of risk, and consequences of use. Substance Use & Misuse 52 (5), 555–561. https://doi.org/10.1080/10826084.2016.1245338.

Breslin, F.C., Sobell, L.C., Sobell, M.B., Agrawal, S., 2000. A comparison of a brief and long version of the Situational Confidence Questionnaire. Behav. Res. and Therapy 38 (12), 1211–1220. https://doi.org/10.1016/S0005-7967(99)00152-7.

Bruneau, J., Ahamad, K., Goyer, M.È., Poulin, G., Selby, P., Fischer, B., Wood, E., 2018. Management of opioid use disorders: a national clinical practice guideline. Canadian Med. Assoc. J. 190 (9), E247–E257. https://doi.org/10.1503/cmaj.170958.

Bürkner, P.C., 2017. brms: an R package for Bayesian multilevel models using Stan. J. Statis. Software 80 (1). https://doi.org/10.18637/jss.v080.i01.

Cicero, T.J., Ellis, M.S., Kasper, Z.A., 2020. Polysubstance use: A broader understanding of substance use during the opioid crisis. American Journal of Public Health 110 (2), 244–250. https://doi.org/10.2105/AJPH.2019.305412.

Ciccocioppo, R., Panocka, I., Froldi, R., Colombo, G., Gessa, G.L., Massi, M., 1999. Antidepressant-like effect of ethanol revealed in the forced swimming test in Sardinian alcohol-preferring rats. Psychopharmacology 144 (2), 151–157. https://doi.org/10.1007/s002130050988.

Cooper, M.L., 1994. Motivations for alcohol use among adolescents: development and validation of a four-factor model. Psychol. Assessment 6 (2), 117–128. https://doi.org/10.1037/1040-3590.6.2.117.

Compton, W.M., Valentino, R.J., DuPont, R.L., 2021. Polysubstance use in the U.S. opioid crisis. Molecular Psychiatry 26 (1), 41–50. https://doi.org/10.1038/s41380-020-00949-3.

Cooper, M.L., Kuntsche, E., Levitt, A., Barber, L.L., Wolf, S., 2016. Motivational models of substance use: a review of theory and research on motives for using alcohol, marijuana, and Tobacco. In K. J. [Ed] Sher (Ed.). The Oxford handbook of substance use and substance use disorders. (1st ed. 1, 1–656. https://doi.org/10.1093/oxfordhb/9780199381678.013.017.

Cox, W.M., Klinger, E., 1988. A motivational model of alcohol use. J. Abnormal Psychol. 97 (2), 168–180. https://doi.org/10.1037//0021-843x.97.2.168.

Crummy, E.A., O'Neal, T.J., Baskin, B.M., Ferguson, S.M., 2020. One is not enough: understanding and modeling polysubstance use. Front. Neurosci. 14 (569) https://doi.org/10.3389/fnins.2020.00569.

Farnum, S., Makarenko, I., Madden, L., Mazhnaya, A., Marcus, R., Prokhorova, T., Altice, F., 2021. The real-world impact of dosing of methadone and buprenorphine in retention on opioid agonist therapies in Ukraine. Addiction 116 (1), 83–93. https://doi.org/10.1111/ADD.15115.

Foster, D.W., Buckner, J.D., Schmidt, N.B., Zvolensky, M.J., 2016. Multisubstance use among treatment-seeking smokers: synergistic effects of coping motives for cannabis and alcohol use and social anxiety/depressive symptoms. Substance Use & Misuse 51 (2), 165–178. https://doi.org/10.3109/10826084.2015.1082596.

Gavrilova, Y., Blevins, C., Abrantes, A., 2020. Modified drinking motives questionnaire–revised: psychometric validation in a psychiatric sample of young adults with predominantly polysubstance use. Addict. Behav., 106753 https://doi.org/10.1016/j.addbeh.2020.106753.

Gold, A.K., Stathopoulou, G., Otto, M.W., 2020. Emotion regulation and motives for illicit drug use in opioid-dependent patients. Cognitive Behaviour Therapy 49 (1), 74–80. https://doi.org/10.1080/16506073.2019.1579256.

Grant, V.V., Stewart, S.H., O'Connor, R.M., Blackwell, E., Conrod, P.J., 2007. Psychometric evaluation of the five-factor modified drinking motives questionnaire - revised in undergraduates. Addict. Behav. 32 (11), 2611–2632. https://doi.org/10.1016/j.addbeh.2007.07.004.

Gray, J.A., 1970. The psychophysiological basis of introversion-extraversion. Behav. Res. Therapy 8 (3), 249–266. https://doi.org/10.1016/0005-7967(70)90069-0.

Gray, J.A. (1987). *The psychology of fear and stress* (2nd ed.). Retrieved from ⟨https://books.google.com/books?hl=en&lr=&id=nww5AAAAIAAJ&oi=fnd&pg=PR6&ots=rpws3qWinZ&sig=WRjkFIkObPbvGhcbGCAiDbbMInA⟩.

Gross, S.R., Barrett, S.P., Shestowsky, J.S., Pihl, R.O., 2002. Ecstasy and drug consumption patterns: a Canadian rave population study. Canadian J. Psychiatry 47 (6), 546–551. https://doi.org/10.1177/070674370204700606.

Hammarberg, A., Öster, C., Nehlin, C., 2017. Drinking motives of adult patients seeking treatment for problematic alcohol use. J. Addict. Diseases 36 (2), 127–135. https://doi.org/10.1080/10550887.2017.1291052.

Jones, R.E., Spradlin, A., Robinson, R.J., Tragesser, S.L., 2014. Development and validation of the opioid prescription medication motives questionnaire: a four-factor model of reasons for use. Psychol. Addict. Behav. 28 (4), 1290–1296. https://doi.org/10.1037/a0037783.

Joyce, K.M., Hudson, A., O'Connor, R., Thompson, K., Hodgin, M., Perrot, T., Stewart, S. H., 2018. Changes in coping and social motives for drinking and alcohol consumption across the menstrual cycle. Depress. Anxiety 35 (4), 313–320. https://doi.org/10.1002/da.22699.

Kruschke, J.K., Liddell, T.M., 2017. The bayesian new statistics: hypothesis testing, estimation, meta-analysis, and power analysis from a Bayesian perspective. Psychonomic Bull. Rev. 25 (1), 178–206. https://doi.org/10.3758/S13423-016-1221-4.

Langleben, D.D., Ruparel, K., Elman, I., Busch-Winokur, S., Pratiwadi, R., Loughead, J., Childress, A.R., 2008. Acute effect of methadone maintenance dose on brain fMRI response to heroin-related cues. Am. J. Psychiatry 165 (3), 390–394. https://doi.org/10.1176/appi.ajp.2007.07010070.

Lucas, P., 2017. Rationale for cannabis-based interventions in the opioid overdose crisis. Harm Reduct. J. 14 (1), 58. https://doi.org/10.1186/s12954-017-0183-9.

Macmadu, A., Carroll, J.J., Hadland, S.E., Green, T.C., Marshall, B.D.L., 2017. Prevalence and correlates of fentanyl-contaminated heroin exposure among young adults who use prescription opioids non-medically. Addict. Behav. 68, 35–38. https://doi.org/10.1016/j.addbeh.2017.01.014.

Mahu, I.T., Conrod, P.J., Barrett, S.P., Sako, A., Swansburg, J., Lawrence, M., Stewart, S. H., 2019. Specificity of personality relationships to particular forms of concurrent substance use among methadone maintenance therapy clients. Addict. Behav. 98 (March), 106056 https://doi.org/10.1016/j.addbeh.2019.106056.

Mattick, R.P., Breen, C., Kimber, J., Davoli, M., 2014. Buprenorphine maintenance versus placebo or methadone maintenance for opioid dependence. Cochrane Database Syst. Rev. 2014 (2) https://doi.org/10.1002/14651858.CD002207.PUB4.

Mezquita, L., Stewart, S.H., Ibáñez, M.I., Ruipérez, M.A., Villa, H., Moya, J., Ortet, G., 2011. Drinking motives in clinical and general populations. Eur. Addict. Res. 17 (5), 250–261. https://doi.org/10.1159/000328510.

Öster, C., Arinell, H., Nehlin, C., 2017. The drinking motives questionnaire among swedish psychiatric patients: an exploration of the four-factor structure. Drug Alcohol Rev. 36 (3), 400–407. https://doi.org/10.1111/dar.12421.

R Core Team. (2013). *R: A language and environment for statistical computing*. Retrieved from ⟨http://www.r-project.org/⟩.

Rigg, K.K., Ibañez, G.E., 2010. Motivations for non-medical prescription drug use: a mixed methods analysis. J. Substance Abuse Treatment 39 (3), 236–247. https://doi.org/10.1016/j.jsat.2010.06.004.

Rouine, J., Callaghan, C.K., O'Mara, S.M., 2018. Opioid modulation of depression: A focus on imaging studies. Progress in Brain Research 239, 229–252. https://doi.org/10.1016/bs.pbr.2018.09.007.

Saxena, P.P., Bodkin, J.A., 2019. Opioidergic Agents as Antidepressants: Rationale and Promise. CNS Drugs 33 (1), 9–16. https://doi.org/10.1007/s40263-018-0584-7.

Schlauch, R.C., Crane, C.A., Houston, R.J., Molnar, D.S., Schlienz, N.J., Lang, A.R., 2015. Psychometric evaluation of the substance use risk profile scale (SURPS) in an inpatient sample of substance users using cue-reactivity methodology. J. Psychopathol. Behav. Assess. 37 (2), 231–246. https://doi.org/10.1007/s10862-014-9462-x.

Simons, J., Correia, C.J., Carey, K.B., Borsari, B.E., 1998. Validating a five-factor marijuana motives measure: relations with use, problems, and alcohol motives. J. Counseling Psychol. 45 (3), 265–273.

Smith, C., Stewart, S.H., O'Connor, R.M., Collins, P., Katz, J., 2011. Development and Psychometric Evaluation of a 10-Item Short Form Inventory of Gambling Situations. Journal of Gambling Studies 27 (1), 115–128. https://doi.org/10.1007/s10899-010-9192.

Socías, M.E., Wood, E., Lake, S., Nolan, S., Fairbairn, N., Hayashi, K., Milloy, M.-J., 2018. High-intensity cannabis use is associated with retention in opioid agonist treatment: a longitudinal analysis. Addiction 113 (12), 2250–2258. https://doi.org/10.1111/add.14398.

Stan Development Team. (2020). *Rstan: the R interface to Stan*. Retrieved from ⟨http://mc-stan.org/⟩.

Stein, M.D., Kanabar, M., Anderson, B.J., Lembke, A., Bailey, G.L., 2016. Reasons for benzodiazepine use among persons seeking opioid detoxification. J. Substance Abuse Treatment 68, 57–61. https://doi.org/10.1016/j.jsat.2016.06.008.

Taylor, O.D., 2015. Poly Substance Use in Methadone Maintenance Therapy (MMT) Patients. Journal of Human Behavior in the Social Environment 25 (8), 822–829. https://doi.org/10.1080/10911359.2015.1028260.

Thornton, L.K., Baker, A.L., Lewin, T.J., Kay-Lambkin, F.J., Kavanagh, D., Richmond, R., Johnson, M.P., 2012. Reasons for substance use among people with mental disorders. Addict. Behav. 37 (4), 427–434. https://doi.org/10.1016/j.addbeh.2011.11.039.

Thurn, D., Kuntsche, E., Weber, J.A., Wolstein, J., 2017. Development and validation of the amphetamine-type stimulants motive questionnaire in a clinical population. Front. Psychiatry 8 (SEP), 25. https://doi.org/10.3389/fpsyt.2017.00183.

Thurn, D., Riedner, A., Wolstein, J., 2020. Use motives of patients with amphetamine-type stimulants use disorder and attention-deficit/hyperactivity disorder. Eur. Addict. Res. 26, 254–262. https://doi.org/10.1159/000508871.

Valente, P.K., Bazzi, A.R., Childs, E., Salhaney, P., Earlywine, J., Olson, J., Biello, K.B., 2020. Patterns, contexts, and motivations for polysubstance use among people who inject drugs in non-urban settings in the U.S. Northeast. Intern. J. Drug Policy 85, 102934. https://doi.org/10.1016/j.drugpo.2020.102934.

Villarosa-Hurlocker, M.C., Bravo, A.J., Pearson, M.R., Prince, M.A., Madson, M.B., Henson, J.M., McChargue, D.E., 2019. The relationship between social anxiety and alcohol and marijuana use outcomes among concurrent users: a motivational model of substance use. Alcoholism: Clin. Experiment. Res. 43 (4), 732–740. https://doi.org/10.1111/acer.13966.

Windle, R.C., Windle, M., 2018. Adolescent precursors of young adult drinking motives. Addict. Behav. 82, 151–157. https://doi.org/10.1016/J.ADDBEH.2018.03.002.

Wolfe, S.A., Workman, E.R., Heaney, C.F., Niere, F., Namjoshi, S., Cacheaux, L.P., Farris, S.P., Drew, M.R., Zemelman, B.V., Harris, R.A., Raab-Graham, K.F., 2016. FMRP regulates an ethanol-dependent shift in GABA B R function and expression with rapid antidepressant properties. Nature Communications 7 (1), 1–13. https://doi.org/10.1038/ncomms12867.

Zvolensky, M.J., Vujanovic, A.A., Bernstein, A., Bonn-Miller, M.O., Marshall, E.C., Leyro, T.M., 2007. Marijuana use motives: a confirmatory test and evaluation among young adult marijuana users. Addict. Behav. 32 (12), 3122–3130. https://doi.org/10.1016/J.ADDBEH.2007.06.010.